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HEALTH AND SAFETY PLAN
ENVIRONMENTAL CONSERVATION AND
CHEMICAL CORPORATION SITE (ECC)
Zionsville, Indiana

Remedial Action Oversight

WA No. 27-5P30 / Contract No. 68-W8-0040

September 26, 1997

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CH2M HILL HEALTH AND SAFETY PLAN

(Reference CH2M HILL SOP 19, *Health and Safety Plans*)

This health and safety plan will be kept on the site during field activities and will be reviewed and updated as necessary. The plan adopts, by reference, the standards of practice (SOP) in the CH2M HILL *Corporate Health and Safety Program, Program and Training Manual*, and CH2M HILL's *Site safety Notebook* as appropriate. The site safety coordinator (SSC) is to be familiar with these SOPs and the content of this plan. Site personnel must sign Attachment 1. In addition, this plan adopts procedures in the work plan for the project.

1 PROJECT INFORMATION AND DESCRIPTION

CLIENT: U.S. EPA Region 5

PROJECT NO: 104147.CV.QS

CH2M HILL SITE MANAGER: Tim Harrison

OFFICE: CIN

CH2M HILL ASSISTANT SITE MANAGER: Bill Andrae

OFFICE: MKE

SITE NAME: Enviro-Chem Corporation (ECC)

SITE ADDRESS: Zionsville, Indiana

DATE HEALTH AND SAFETY PLAN PREPARED: July 29, 1997

DATE(S) OF INITIAL VISIT: August 7, 1997

DATE(S) OF SITE WORK: September 1997 through December 2000

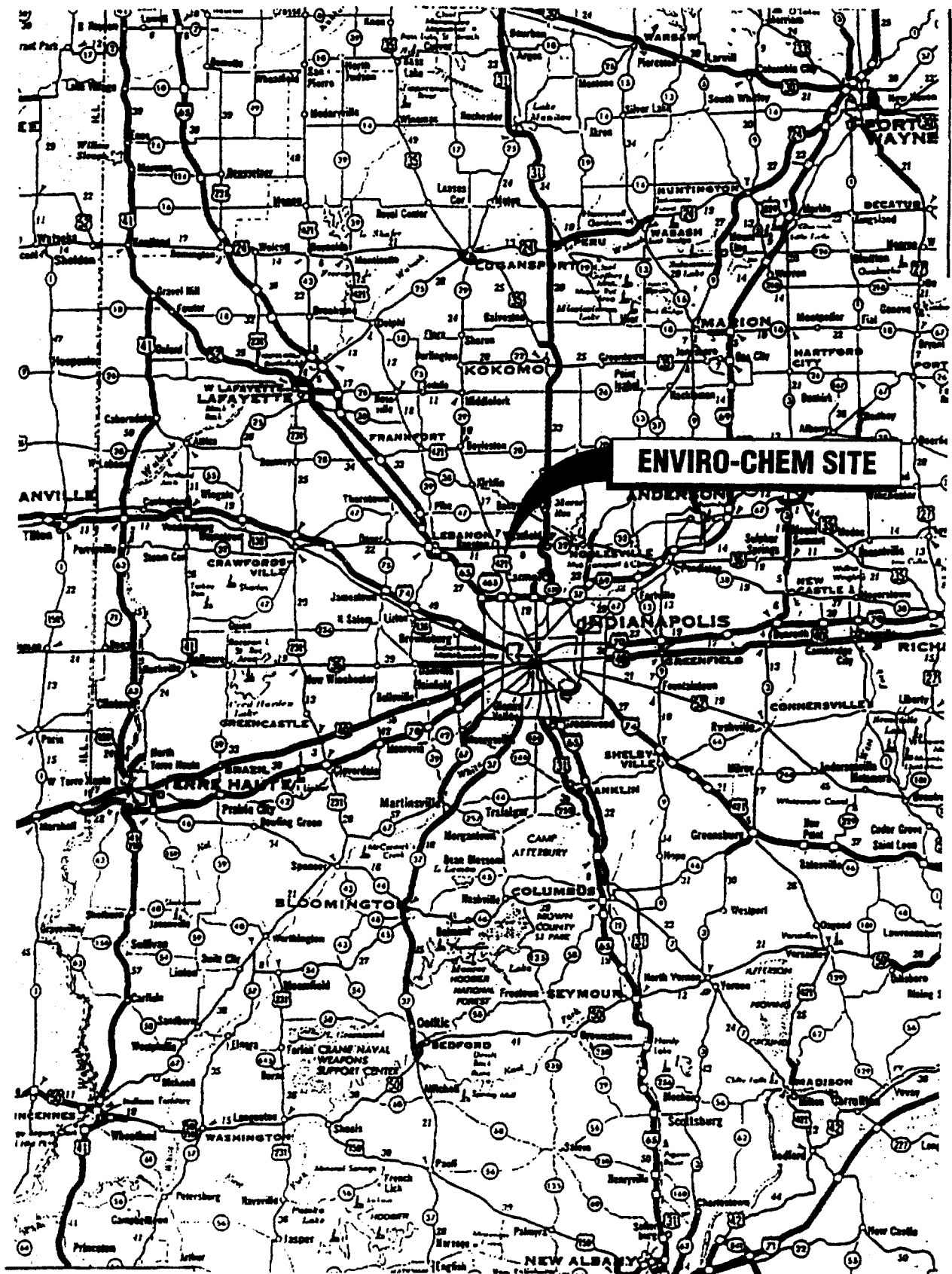
SITE ACCESS: Vehicular access to the site is by means of a service road that intersects U.S. Highway 421 directly west of the site.

SITE SIZE: Approximately 6.5 acres

SITE TOPOGRAPHY: The site is rectangular and relatively flat. The southern end of the site is covered by a concrete pad. The remainder of the site is covered by tall grass. Immediately east of the ECC site is the Northside Sanitary Landfill (NSL) National Priority List (NPL) site.

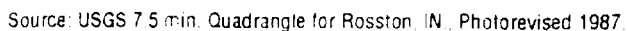
PREVAILING WEATHER: The mean monthly temperatures ranges from 25.5°F (January) to 75.3°F (July). Average seasonal precipitation ranges from 11.2 inches in summer (June through August) to 7.7 inches in winter (December through February). The predominant upper level jet stream is from the west-northwest.

SITE DESCRIPTION AND HISTORY: The ECC site is located near the town of Zionsville, Boone County, Indiana, approximately 10 miles northwest of Indianapolis along U.S. Highway 421 (Figure 1-1). It is bounded on the east by the Northside Sanitary Landfill (NSL) National Priority List site (Figure 1-2). An unnamed ditch separates the two facilities. Several residential homes are located within 1/2 mile of the site to the north and west.



0 10
APPROXIMATE
SCALE IN MILES

FIGURE 1-1
Site Location Map
Enviro-Chem Superfund Site



CH2MHILL

The ECC site was a 6.5 acre solvent recycling facility engaged in recovery, reclamation, and brokering of primary solvents, oils, and other wastes received from industrial clients. Waste materials were received in drums and bulk tankers and prepared for reclamation or disposal. Drum shipments to the site were halted in February 1982.

The EPA investigated the site and placed it on the NPL in 1983. In 1983 and 1984, interim remedial action at the site by the EPA included cleanup of drums, containers, and a sludge lagoon, and removal of certain contaminated soils. Remedial investigation of the site began in 1983 and continued through December 1984. Results of that investigation were issued in a Remedial Investigation Report in 1986.

A feasibility study for the site was conducted in late 1986. A Combined Alternatives Analysis for both the ECC and NSL sites was issued in December 1986. In the Record of Decision (ROD) signed September 25, 1987, the EPA chose combined Alternative No. 5, which consisted of groundwater interception and treatment and construction of a RCRA-compliant cap, for remediation of the two sites.

Before the remedial action to close the sites was designed, predesign field investigations to characterize chemical and physical conditions at both sites were conducted in 1987 and 1988. Work included sampling and analysis of groundwater and soil to characterize contamination in the supplemental investigation area south of the ECC site and southwest of the NSL site. The ECC PRP-directed consultants conducted additional sampling and analyses in 1987 and a soil vapor extraction pilot study in the summer of 1988.

The PRP group for the ECC site (ECC Trust) and their consultants are conducting the design and construction of the closure. A consent decree was signed by some of the PRPs, henceforth called the Settling Defendants.

As a result of changes in the selected remedial action identified during consent decree negotiations, the EPA issued a ROD amendment detailing the revised remedial action objectives. The ROD was amended on June 7, 1991. Separate, complementary remedies for each site will be implemented instead of the single combined remedy for both sites selected in the 1987 ROD. The major components of the consent decree remedial action for the ECC site include:

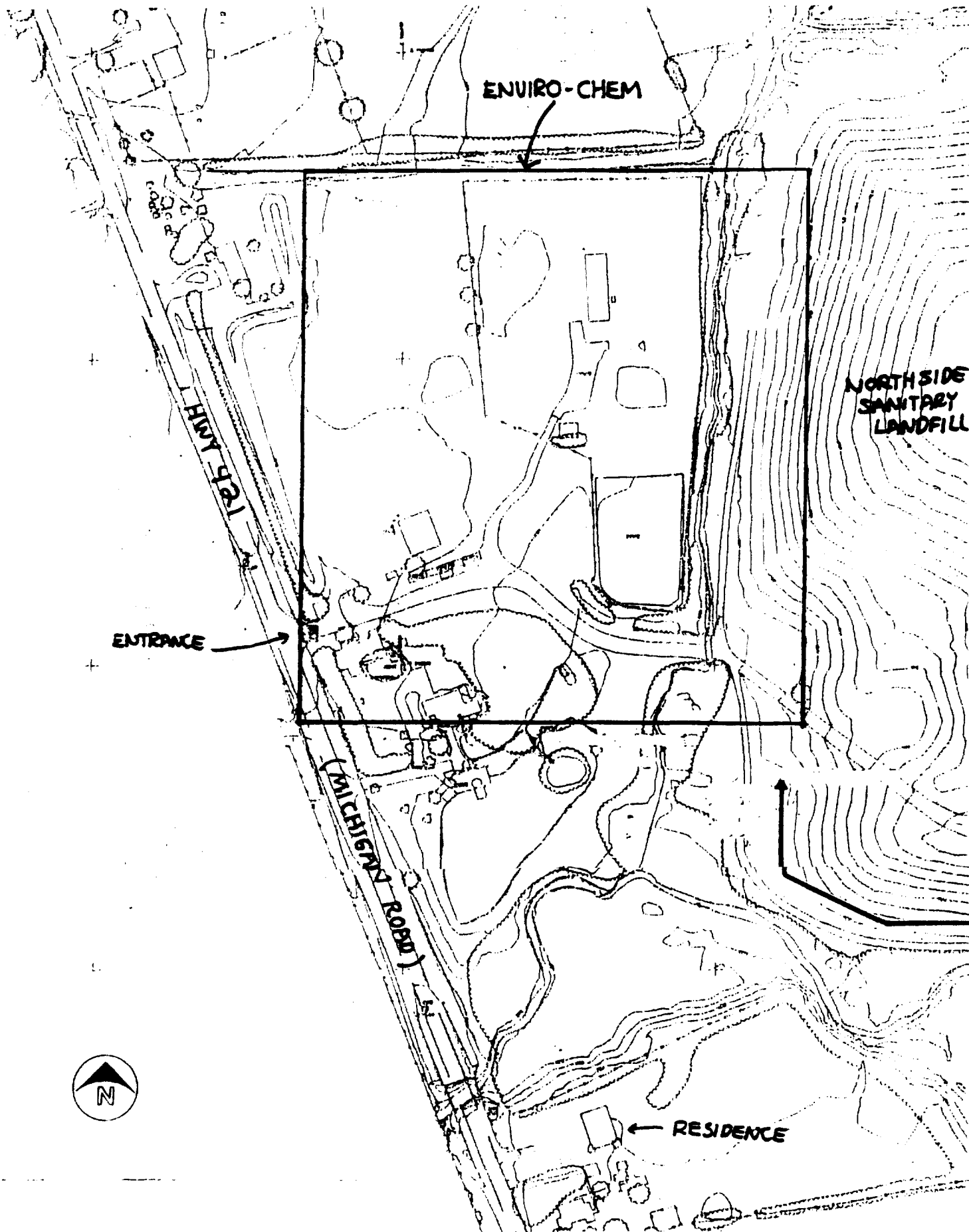
- An enhanced soil vapor extraction system designed to remove and destroy volatile organic compounds (VOCs) to acceptable soil concentrations
- A RCRA compliant cap (Subtitle C) to prevent direct contact with surface soils and to minimize the rest of remaining soil contaminants migrating into the groundwater.
- Construction of a fence around the perimeter of the site and the posting of warning signs
- An onsite system for monitoring groundwater quality in the till unit
- An offsite groundwater monitoring system in the till and sand and gravel units to monitor the effectiveness of the remedy
- Surface water monitoring to determine the effectiveness of the remedy
- Deed and use restrictions to limit future uses of the site

The consent decree was entered on September 10, 1991, officially initiating remedial design and remedial action (RD/RA) activities at the site. Based on data collected by the ECC Trust after 1991, the remedial action was revised. Studies showed the southern one-third of the site to be water saturated. As a result of this information, the ECC Trust developed a "Revised Remedial Action (RRA)". Major changes include:

- Excavation of soils and concrete at the southern end of the site and placement on the northern end for treatment by SVE.
- Backfill of excavated area with native soils.

- Modifications to the final cover system.

The revised Exhibit A and Consent Decree were approved by USEPA in august 1996.



Enviro-Chem Site Map



2 PROJECT ORGANIZATION AND TASKS TO BE PERFORMED UNDER THIS PLAN

2.1 PROJECT ORGANIZATION

CLIENT: U.S. EPA Region 5

REMEDIAL PROJECT MANAGER: Michael McAteer

CH2M HILL:

Site Manager: Tim Harrison/CIN

Assistant Site Manager: Bill Andrae/MKE

Field Team Leader: Refer to Section 4

Refer to Section 4 for field staff.

CONTRACTORS and SUBCONTRACTORS: Refer to Section 4.2.

2.2 DESCRIPTION OF TASKS *(Reference Section 1, "Field Activity Start-up Form," of Site Safety Notebook)*

CH2M HILL's role is to observe field activities performed by contractors for the PRP group (referred to in this document as the "ECC Trust"). CH2M HILL will also collect co-located soil, groundwater, and surface water samples as part of U.S. EPA's role in remedial action activities. CH2M HILL will notify the appropriate authorities of any possible field activity that, in the opinion of the observer, does not conform to the documents governing the remedial action plan. CH2M HILL will not direct, advise, or make recommendations to the Settling Defendants or any representative while performing these tasks.

According to EPA-approved documents, the activities that will be conducted by the resident observer during the remedial action are as follows:

- Observe all construction and sampling activities performed by the remedial contractors on behalf of the ECC Trust. Major activities include:
- Excavation of the southern one-third of the site to a depth of 9 feet with placement at the north end of the site.
- Installation and operation of SVE at north two-thirds of the site.
- Installation of RCRA-compliant cap.
- Exit sampling of excavation.
- Fill excavation with native soils.
- Grout 20' x 20' x 12' sump.
- Crush concrete pad (<3" diameter), place and treat by SVE system.
- Collection, treatment, and direct discharge of water from sump, all excavation activities, and SVE system.

Collect co-located samples of surface water, groundwater (from monitoring wells), and soils. This includes sampling of sidewall excavated area (9 ft. deep). The remedial contractors for the ECC Trust will lead all sampling efforts.

The SSC level of CH2M HILL personnel working onsite will be consistent with the requirements of the activity being performed at the time. If site conditions change, appropriate SSC level personnel may be brought in to accommodate site needs.

2.2.1 HAZWOPER-REGULATED TASKS

- Co-located surface soil sampling
- Co-located sidewall sampling of excavation
- Co-located groundwater sampling
- Co-located surface water sampling
- Oversight of construction activities

2.2.2 NON-HAZWOPER-REGULATED TASKS

None

3 HAZARD EVALUATION AND CONTROL

3.1 HEAT AND COLD STRESS (Reference CH2M HILL SOP HS-09, *Heat and Cold Stress*)

3.1.1 PREVENTING HEAT STRESS

- Drink 16 ounces of water before beginning work, such as in the morning or after lunch. Disposable (e.g., 4-ounce) cups and water maintained at 50° to 60°F should be available. Under severe conditions, drink 1 to 2 cups every 20 minutes, for a total of 1 to 2 gallons per day. Take regular breaks in a cool, preferably air-conditioned, area. Do not use alcohol in place of water or other nonalcoholic fluids. Decrease your intake of coffee and caffeinated soft drinks during working hours. Monitor for signs of heat stress.
- Acclimate to site work conditions by slowly increasing workloads; e.g., do not begin site work with extremely demanding activities.
- Use cooling devices, such as cooling vests, to aid natural body ventilation. The devices add weight, so their use should be balanced against efficiency.
- Use mobile showers or hose-down facilities to reduce body temperature and cool protective clothing.
- During hot weather, conduct field activities in the early morning or evening if possible.
- Provide adequate shelter to protect personnel against radiant heat (sun, flames, hot metal), which can decrease physical efficiency and increase the probability of heat stress.
- In hot weather, rotate shifts of workers.
- Maintain good hygiene standards by frequently changing clothing and by showering. Clothing should be permitted to dry during rest periods. Persons who notice skin problems should consult medical personnel.

3.1.2 SYMPTOMS AND TREATMENT OF HEAT STRESS

	Heat Syncope	Heat Rash (<i>miliaria rubra</i> , "prickly heat")	Heat Cramps	Heat Exhaustion	Heat Stroke
Signs and Symptoms	Sluggishness or fainting while standing erect or immobile in heat.	Profuse tiny raised red blister-like vesicles on affected areas, along with prickling sensations during heat exposure.	Painful spasms in muscles used during work (arms, legs, or abdomen); onset during or after work hours.	Fatigue, nausea, headache, giddiness; skin clammy and moist; complexion pale, muddy, or flushed; may faint on standing; rapid thready pulse and low blood pressure; oral temperature normal or low	Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high oral temperature.
Treatment	Remove to cooler area. Rest lying down. Increase fluid intake. Recovery usually is prompt and complete.	Use mild drying lotions and powders, and keep skin clean for drying skin and preventing infection.	Remove to cooler area. Rest lying down. Increase fluid intake.	Remove to cooler area. Rest lying down, with head in low position. Administer fluids by mouth. Seek medical attention.	Cool rapidly by soaking in cool—but not cold—water. Call ambulance, and get medical attention immediately!

3.1.3 HEAT-STRESS MONITORING

For field activities part of ongoing site work activities in hot weather, the following procedures should be used to monitor the body's physiological response to heat and to estimate the work-cycle/rest-cycle when workers are performing moderate levels of work. These procedures should be considered when the ambient air temperature exceeds 70°F, the relative humidity is high(>50%), or when the workers exhibit symptoms of heat stress.

The heart rate should be measured by the radial pulse for 30 seconds, as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 110 beats/minute, or 20 beats/minute above resting pulse. If the HR is higher, the next work period should be shortened by 33 percent, while the length of the rest period stays the same. If the pulse rate still exceeds 110 beats/minute at the beginning of the next rest period, the following work cycle should be further shortened by 33 percent. The procedure is continued until the rate is maintained below 110 beats/minute, or 20 beats/minute above resting pulse.

3.1.4 PREVENTING COLD STRESS

- Be aware of the symptoms of cold-related disorders, and **wear proper clothing for the anticipated fieldwork**.
- Consider monitoring the work conditions and adjusting the work schedule, using guidelines developed by the U.S. Army (wind-chill index) and the National Safety Council (NSC).
- **Wind-Chill Index.** This measure relates the dry bulb temperature and the wind velocity. It is used only to estimate the combined effect of wind and low air temperatures on exposed skin. The wind-chill index sometimes is limited in its usefulness because the index does not take into account the body part that is exposed, the level of activity, or the amount or type of clothing worn. For those reasons, it is used only as a guideline to warn workers when they are in a situation that can cause cold-related illnesses. Used in conjunction with the NSC guidelines, the wind-chill index provides a starting point for adjusting work and warm-up schedules.
- **NSC Guidelines for Work and Warm-Up Schedules.** The cold-exposure limits recommended by the NSC can be used in conjunction with the wind-chill index to estimate work and warm-up schedules for fieldwork. The guidelines are not absolute; **workers should be monitored for symptoms of cold-related illness**. If symptoms are not observed, the work duration can be increased.
- The wind-chill index and the NSC guidelines are in the CH2M HILL *Corporate Health and Safety Program, Program and Training Manual*, SOP HS-09.

3.1.5 SYMPTOMS AND TREATMENT OF COLD STRESS

	Immersion (Trench) Foot	Frostbite	Hypothermia
Signs and Symptoms	Feet discolored and painful; infection and swelling present.	Blanched, white, waxy skin, but tissue resilient; tissue cold and pale.	Shivering, apathy, sleepiness, rapid drop in body temperature; glassy stare; slow pulse; slow respiration.
Treatment	Seek medical treatment immediately.	Remove victim to a warm place. Rewarm area quickly in warm—but not hot—water. Have victim drink warm fluids, but not coffee or alcohol. Do not break blisters. Elevate the injured area, and get medical attention.	Remove victim to a warm place. Have victim drink warm fluids, but not coffee or alcohol. Get medical attention.

3.2 PROCEDURES FOR LOCATING BURIED UTILITIES

Not applicable. All subsurface utility identification will be the responsibility of the remedial contractor.

3.3 GENERAL PHYSICAL (SAFETY) HAZARDS AND CONTROLS

Engineering and administrative controls are to be implemented by the party in control of the site or the hazard (i.e., CH2M HILL, subcontractor, or contractor). CH2M HILL employees and subcontractors must, at a minimum, remain aware of hazards affecting them regardless of who is responsible for controlling the hazards. Specialty subcontractors are responsible for the safe operation of their equipment (e.g., drill rig, heavy equipment). CH2M HILL employees are not to operate, or assist in the operation of, any subcontractor or contractor equipment.

Hazard (Refer to SOP, or HSP Section)	Engineering Controls, Administrative Controls, and Work Practices	Surface Water and Sediment Sampling from the Shore or Water	Hand Augering	Observation of Loading of Material for Offsite Disposal	Remediation and Construction Oversight
Flying debris/objects (HS-07)	Provide shielding and PPE; maintain distance.	X	X	X	X
Noise > 85 dBA	Noise protection and monitoring required.			X	X
Gas cylinders (HS-21)	Instruct employees in the safe use of compressed gases. Make certain gas cylinders are properly anchored and chained. Keep cylinders away from ignition sources. Cap cylinders when not in use.				
Electrical	<ul style="list-style-type: none"> Make certain third wire is properly grounded. Do not tamper with electrical wiring unless qualified to do so. Ground as appropriate. Project field sites should have ground fault circuit interrupters (GFCIs) installed for all wiring, including extension cords. Heavy equipment (e.g., drill rig) should remain at least 15 feet from overhead power line for power lines of 50 kV or less. For each 10 kV > 50, increase distance by ½ foot. Operate and maintain equipment according to manufacturer's instructions. Use only extension cords that are three-wire grounded. Cords passing through work areas must be covered or elevated to protect from damage. Use only electrical tools and equipment that are either effectively grounded or double-insulated UL approved. Properly label switches, fuses, and circuit breakers. Remove cord from an outlet by grasping the plug, not pulling the cord. Protect all electrical equipment, tools, switches, etc., from elements. Avoid physical contact with power circuit. Only qualified electricians are to install and work on electrical circuits and equipment. 				X
Suspended loads	Work not permitted under suspended loads.			X	X
Slip, trip, fall hazards (e.g., wet/muddy surface, inadequate railing, unstable surface)	Provide slip-resistant surfaces, ropes, and/or other devices to be used. Brace and shore equipment	X	X	X	X
Back injury (HS-29)	Use proper lifting techniques, or provide mechanical lifting aids.	X	X		X
Confined space entry (Section 9.0)	Space must be evaluated by qualified person. Additional controls and monitoring, training, and an approved entry permit are generally required.	NOT APPROVED			
Trenches/excavations (HS-32)	<ul style="list-style-type: none"> Make certain excavation meets OSHA standard before entering. Personnel and equipment must remain at least 2 feet from edge of excavation at all times. Barricade all excavations. Daily inspections of excavations, the adjacent areas, and protective systems shall be made by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. CH2M HILL must obtain authorization from the competent person prior to 				X

3.3 GENERAL PHYSICAL (SAFETY) HAZARDS AND CONTROLS

Engineering and administrative controls are to be implemented by the party in control of the site or the hazard (i.e., CH2M HILL, subcontractor, or contractor). CH2M HILL employees and subcontractors must, at a minimum, remain aware of hazards affecting them regardless of who is responsible for controlling the hazards. Specialty subcontractors are responsible for the safe operation of their equipment (e.g., drill rig, heavy equipment). CH2M HILL employees are not to operate, or assist in the operation of, any subcontractor or contractor equipment.

Hazard (Refer to SOP, or HSP Section)	Engineering Controls, Administrative Controls, and Work Practices	Surface Water and Sediment Sampling from the Shore or Water	Hand Augering	Observation of Loading of Material for Offsite Disposal	Remediation and Construction Oversight
	entering the excavation, and follow all excavation requirements established by the competent person. <ul style="list-style-type: none"> Do not enter the excavation if inadequate protection or soil movement is observed. Report findings to the competent person. 				X
Protruding objects	Flag visible objects.	X	X	X	X
Visible lightning	Stop work.	X	X	X	X
Fire prevention and control (HS-22)	<ul style="list-style-type: none"> No spark sources are allowed within exclusion or decontamination zones. Appropriate firefighting equipment must be available on the site. Extinguishers are to be inspected visually every month and undergo an annual maintenance check. Post "Exit" signs over exiting doors, and post "Fire Extinguisher" signs over extinguisher locations. Keep areas near exits and extinguishers clear. Open flames are prohibited in the vicinity of flammable materials. Combustible materials stored outside should be at least 10 feet from the building. Unnecessary combustible materials and flammable or combustible liquids must not be allowed to accumulate. Flammable or combustible liquids must be kept in approved containers, and must be stored in an approved storage cabinet. 	X			X
Inadequate illumination	Site work will be performed during daylight hours whenever possible. Work conducted during hours of darkness will require enough illumination intensity "to read a newspaper without difficulty."	X	X	X	X
Entanglement in rotating equipment	<ul style="list-style-type: none"> Prohibit loose clothing and hair Prohibit wearing jewelry 		X		
Heavy equipment	<ul style="list-style-type: none"> Become familiar with hazards specific to the equipment being used. Always confirm that the operator is aware of your location, particularly when you approach or pass by equipment. Backup alarm is required for heavy equipment. Do not count on backup alarms always functioning. Look around when alarm sounds. Do not ride equipment not designed for passengers. Do not climb on operating equipment. Do not place yourself between fixed and moving parts or objects. Do not stand adjacent to the equipment. Stay clear of equipment on cross slopes and unstable terrain. Stay clear of pile-driving operations. Stay outside the turning radius of the equipment. Operators using all-terrain vehicles (ATV) must be trained; other ATV requirements may apply. Observer must remain in contact with operator and signal safe backup. Personnel must remain outside the turning radius. 			X	X

3.4 BIOLOGICAL HAZARDS AND CONTROLS

Hazard and Location	Control Measures
Snakes typically are found in underbrush and tall grassy areas.	If you encounter a snake, stay calm and look around; there may be other snakes. Turn around and walk away on the same path you used to approach the area. If a person is bitten by a snake, wash and immobilize the injured area, keeping it lower than the heart if possible. Seek medical attention immediately. DO NOT apply ice, cut the wound, or apply a tourniquet. Carry the victim or have him/her walk slowly if the victim must be moved. Try to identify the type of snake: note color, size, patterns, and markings.
Poison ivy, poison oak, and poison sumac typically are found in brush or wooded areas. They are more commonly found in moist areas or along the edges of wooded areas.	Become familiar with the identity of these plants. Wear protective clothing that covers exposed skin and clothes. Avoid contact with plants and the outside of protective clothing. If skin contacts a plant, wash the area with soap and water immediately. If the reaction is severe or worsens, seek medical attention.
Exposure to bloodborne pathogens may occur when rendering first aid or CPR, or when coming into contact with medical or other potentially infectious material, or when coming into contact with landfill waste or waste streams containing such infectious material.	Training is required before a task involving potential exposure is performed. Exposure controls and personal protective equipment (PPE) are required as specified in CH2M HILL SOP HS-36, <i>Bloodborne Pathogens</i> . Hepatitis B vaccination must be offered before the person participates in a task where exposure is a possibility.
Bees and other stinging insects may be encountered almost anywhere and may present a serious hazard, particularly to people who are allergic.	Watch for and avoid nests. Keep exposed skin to a minimum. Carry a kit if you have had allergic reactions in the past, and inform the SSC and/or the buddy. If a stinger is present, remove it carefully with tweezers. Wash and disinfect the wound, cover it, and apply ice. Watch for allergic reaction; seek medical attention if a reaction develops.

Other Potential Biological Hazards:

None anticipated.

3.5 TICK BITES (Reference CH2M HILL HS-03, *Tick Bites*)

Ticks typically are in wooded areas, bushes, tall grass, and brush. Ticks are black, black and red, or brown and can be up to one-quarter inch in size.

Prevention against tick bites includes avoiding tick areas; wearing tightly woven light-colored clothing with long sleeves and wearing pant legs tucked into boots or socks; spraying **only outside** of clothing with insect repellent containing permethrin or permethrin, and spraying skin with DEET; and checking yourself frequently for ticks and showering as soon as possible. To prevent chemical repellents from interfering with sample analyses, exercise care while using repellents during the collection and handling of environmental samples.

If bitten by a tick, carefully remove the tick with tweezers, grasping the tick as close as possible to the point of attachment while being careful not to crush the tick. After removing the tick, wash your hands and disinfect and press the bite area. The removed tick should be saved. Report the bite to human resources personnel.

Look for symptoms of Lyme disease or Rocky Mountain spotted fever (RMSF). Lyme: a rash that looks like a bullseye with a small welt in the center. RMSF: a rash of red spots under the skin 3 to 10 days after the tick bite. In both cases, chills, fever, headache, fatigue, stiff neck, bone pain may develop. If symptoms appear, seek medical attention.

3.6 RADIOLOGICAL HAZARDS AND CONTROLS

Refer to CH2M HILL's *Corporate Health and Safety Program, Program and Training Manual*, and *Corporate Health and Safety Program, Radiation Protection Program Manual*, for standards of practice for operating in contaminated areas

Hazards	Controls
None Known	None Required

3.7 HAZARDS POSED BY CHEMICALS BROUGHT ON THE SITE

3.7.1 HAZARD COMMUNICATION

(Reference CH2M HILL *Hazard Communication Manual* and Section 5 of the *Site Safety Notebook*)

CH2M HILL's *Hazard Communication Program Manual*, which is available from area or regional offices and from the Corporate Human Resources Department in Denver. The project manager is to request Material Safety Data Sheets (MSDSs) from the client or from the contractors and the subcontractors for chemicals to which CH2M HILL employees potentially are exposed. The SSC is to do the following:

- Give employees required site-specific HAZCOM training.
- Confirm that the inventory of chemicals brought on the site by subcontractors is available.
- Before or as the chemicals arrive on the site, obtain an MSDS for each hazardous chemical.
- Label chemical containers with the identity of the chemical and with hazard warnings, if any.

The chemical products listed below will be used on the site. Refer to Attachment 2 for MSDSs.

Chemical	Quantity	Location
Methane (calibration gas)	1 liter, compressed gas	Support Zone
Isobutylene (calibration gas)	1 liter, compressed gas	Support Zone
Pentane (calibration gas)	1 liter, compressed gas	Support Zone
Hydrochloric Acid (sample preservative)	< 500 ml	Support/Exclusion Zone
Nitric Acid (sample preservative)	< 500 ml	Support/Exclusion Zone
Methanol (decontamination solvent)	< 1 gallon	Support/Decontamination Zone
MSA Sanitizer (respirator cleaner)	< 1 liter, powder	Support/Decontamination Zone
Hydrogen (OPTIONAL - if FID is used)	cylinder	Support/Exclusion Zone
Alconox/Liquinox (detergent)	< 1 liter, powder/liquid	Support/Decontamination Zone

3.7.2 SHIPPING AND TRANSPORTATION OF CHEMICAL PRODUCTS

(Reference CH2M HILL's *Procedures for Shipping and Transporting Dangerous Goods*)

Nearly all chemicals brought to the site are considered hazardous materials by the U.S. Department of Transportation (DOT). All staff who ship the materials or transport them by road must receive the CH2M HILL training in shipping dangerous goods. All hazardous materials that are shipped (e.g., via Federal Express) or are transported by road must be properly identified, labeled, packed, and documented by trained staff. Contact the HSM or the Equipment Coordinator for additional information.

3.8 CONTAMINANTS OF CONCERN (REFER TO PROJECT FILES FOR MORE-DETAILED CONTAMINANT INFORMATION)

Contaminant	Location and Highest Concentration (ug/kg)	Exposure Limit^b	IDLH^c	Symptoms and Effects of Exposure	PIP^d (eV)
Acetone	GW: SB: 650,000 SS:	250 ppm	2,500 ppm (LEL)	CNS depression and narcosis. Mildly irritating to skin and eyes.	9.69
2-Butanone (Methyl Ethyl Ketone, MEK)	GW: SB: 2,800,000 SS:	200 ppm	3,000	Eye, skin, and nose irritation; headache, dizziness, vomiting, dermatitis	9.54
Chloroform	GW: SB: 2,900 SS:	2 ppm	500 Ca	Dizziness, mental dullness, nausea, confusion, disorientation, headache, fatigue, eye and skin irritation, anesthesia, enlarged liver	11.42
1,1-Dichloroethane	GW: SB: 35,000 SS:	100 ppm	3,000	CNS depression, skin irritation; liver, kidney, and lung damage	11.06
1,1-Dichloroethene (Vinylidene Chloride)	GW: SB: 380 SS:	5 ppm	-- Ca	CNS depression, eye and skin irritat. Liver and kidney carcinogen.	9.66
Ethylbenzene	GW: SB: 1,500,000 SS:	100 ppm	800	Eye, skin, and mucous membrane irritation; headache; dermatitis; narcotic; coma	8.76
Methylene Chloride (Dichloromethane)	GW: SB: 310,000 SS:	500 ppm	2,300 Ca	Fatigue, weakness, sleepiness, light-headedness, numbness and tingling in limbs, nausea, irritant to eyes and skin, carcinogen	11.32
Methyl Isobutyl Ketone (MIBK, Hexone)	GW: SB: 190,000 SS:	50 ppm	500	Irritant to eyes and mucous membranes, headache, narcosis, coma, dermatitis, peripheral neuropathy.	9.30
1,1,1-Trichloroethane	GW: SB: 1,100,000 SS:	10 ppm	700 Ca	Headache, dizziness, eye irritant, dermatitis, cardiac arrhythmia, liver damage, kidney damage.	11.00
Tetrachloroethene (Perchloroethene)	GW: SB: 650,000 SS:	25 ppm	150 Ca	Eye, nose, and throat irritation; nausea; flushed face and neck; vertigo, dizziness; sleepiness; skin redness; headache; liver damage	9.32

3.8 CONTAMINANTS OF CONCERN (REFER TO PROJECT FILES FOR MORE-DETAILED CONTAMINANT INFORMATION)

Contaminant	Location and Highest Concentration (ug/kg)	Exposure Limit ^b	IDLH ^c	Symptoms and Effects of Exposure	PIP ^d (eV)
1,1,2-Trichloroethane	GW: SB: 550 SS	10 ppm	100 Ca	Eye and nose irritation, CNS depression, liver damage, dermatitis	11.00
Trichloroethene (TCE)	GW: SB: 4,800,000 SS	25 ppm	1,000 Ca	Headache, vertigo, visual disturbance, eye and skin irritation, fatigue, giddiness, tremors, sleepiness, nausea, vomiting, dermatitis, cardiac arrhythmia, paresthesia, liver injury	9.45
Toluene	GW: SB: 2,000,000 SS	50 ppm	500	Eye and nose irritation, fatigue, weakness, confusion, dizziness, headache, dilated pupils, excessive tearing, nervousness, muscle fatigue, paresthesia, dermatitis, liver and kidney damage	8.82
Xylenes (total)	GW: SB: 6,800,000 SS:	100 ppm	900	Irritated eyes, skin, nose, throat; dizziness; excitement; drowsiness; incoherence; staggering gait; corneal vacuolization; anorexia; nausea; vomiting; abdominal pain; dermatitis	8.56

Footnotes:

- a: Specify sample-designation and media: SB (Soil Boring), A (Air), D (Drums), GW (Groundwater), L (Lagoon), TK (Tank), SS (Surface Soil), SL (Sludge), SW (Surface Water),
b: Appropriate value of PEL, REL, or TLV listed
c: IDLH = immediately dangerous to life and health (units are the same as specified "Exposure Limit" units for that contaminant); NL = No limit found in reference materials; CA = Potential occupational carcinogen
d: PIP = photoionization potential; NA = Not applicable; UK = Unknown

3.9 POTENTIAL ROUTES OF EXPOSURE

DERMAL: Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in Section 5.

INHALATION: Vapors and contaminated particulates. This route of exposure is minimized through proper respiratory protection and monitoring, as specified in sections 5 and 6, respectively.

OTHER: Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before eating, drinking, or smoking).

4 PERSONNEL

4.1 CH2M HILL EMPLOYEE MEDICAL SURVEILLANCE AND TRAINING

(Reference CH2M HILL SOP HS-01, *Medical Surveillance*, and HS-02, *Health and Safety Training*)

The employees listed below are enrolled in the CH2M HILL Comprehensive Health and Safety Program and meet state and federal hazardous waste operations requirements for 40-hour initial training, 3-day on-the-job experience, and 8-hour annual refresher training. Employees designated "SSC" have received 8 hours of supervisor and instrument training and can serve as site safety coordinator (SSC) for the level of protection indicated. An SSC with a level designation (D, C, B) equal to or greater than the level of protection being used must be present during all tasks performed in exclusion or decontamination zones that involve the potential for exposure to health and safety hazards. Employees designated "FA-CPR" are currently certified by the American Red Cross, or equivalent, in first aid and CPR. At least one FA-CPR designated employee must be present during all tasks performed in exclusion or decontamination zones that involve the potential for exposure to health and safety hazards. The employees listed below are currently active in a medical surveillance program that meets state and federal regulatory requirements for hazardous waste operations. Certain tasks (e.g., confined-space entry) and contaminants (e.g., lead) may require additional training and medical monitoring.

Pregnant employees are to be informed of and are to follow the procedures in CH2M HILL's SOP HS-04, *Reproduction Protection*, including

obtaining a physician's statement of the employee's ability to perform hazardous activities, before being assigned fieldwork.

Employee Name	Office	Responsibility	SSC/FA-CPR
Richard Baldino	MKE	Resident Observer	Level D SSC; FA-CPR
Cathy Barnett	MKE	Resident Observer	FA-CPR
Seth Bryson	MKE	Resident Observer/SSC	Level D SSC; FA-CPR
Tim Harrison	CIN	Site Manager/Resident Observer/SSC	Level D SSC; FA-CPR
Jeffrey Meerdink	MKE	Resident Observer/SSC	CPR
Mark Petershock	MKE	Resident Observer/SSC	Level D SSC; FA-CPR
Dong-son Pham	MKE	Resident Observer/SSC	Level D SSC; FA-CPR
Michelle Redfield	CHI	Resident Observer/SSC	Level C SSC; FA-CPR
Dave Shekoski	MKE	Resident Observer/SSC	Level C SSC; FA-CPR
Erik Spande	CHI	Resident Observer/SSC	Level C SSC; FA-CPR
Alan Wells	DAY	Resident Observer/SSC	Level C SSC; FA-CPR
Patrick Allen	MKE	Resident Observer	FA-CPR
Bill Andrus	MKE	Resident Observer	Level D SSC; FA-CPR

4.2 FIELD TEAM CHAIN OF COMMAND AND COMMUNICATION PROCEDURES

4.2.1 CLIENT

Contact Name: Michael McAteer, U.S. EPA

Phone (312) 886-4663

Facility Contact Name: N/A

Phone N/A

4.2.2 CH2M HILL

Site Manager: Tim Harrison/MKE

Assistant Site Manager: Bill Andrae/MKE

Health and Safety Manager: Richard Rathnow/MKE

Field Team Leader: Resident observer will act as Field Team Leader

Site Safety Coordinator: Resident observer will act as SSC

The SSC is responsible for contacting the field team leader and the project manager. In general, the project manager either will contact or will identify the client contact. The Health and Safety Manager (HSM) should be contacted as appropriate. The SSC or the project manager must notify the client and the HSM when a serious injury or a death occurs or when health and safety inspections by OSHA or other agencies are conducted. Refer to sections 10 through 12 for emergency procedures and phone numbers.

4.2.3 SUBCONTRACTORS

(Reference Section 3, Corporate Health and Safety Program Manual)

When specified in the project documents (e.g., contract), this plan may cover CH2M HILL subcontractors. However, this plan does not address hazards associated with tasks and equipment that the subcontractor has expertise in (e.g., operation of drill rig). Specialty subcontractors are responsible for health and safety procedures and plans specific to their work. Specialty subcontractors are to submit plans to CH2M HILL for review and approval before the start of fieldwork. Subcontractors must comply with the established health and safety plan(s). CH2M HILL must monitor and enforce compliance with the established plan(s).

Subcontractor: CH2M HILL will have no subcontractors onsite.

Subcontractor Contact: N/A

Telephone: N/A

4.2.4 CONTRACTORS

(Reference Section 3, *Corporate Health and Safety Program Manual*)

This plan does not cover contractors that are contracted directly to the client or the owner. CH2M HILL is not responsible for directing contractor personnel and is not to assume responsibility through their actions. When the contractor is in control of the site, ask the contractor to conduct a briefing of their health and safety practices and to describe how they apply to CH2M HILL's activities. Request a copy of the contractor's health and safety plan.

Contractor: Radian International (Pittsburgh, PA)
Contact Name: Mark Dowiak P.G., Project Manager
Telephone: (412) 788-2717

Contractor (Engineering oversight): ERM - North Central, Inc. (Dearfield, IL)
Contact Name: Dr. Roy Ball
Telephone: (847) 940-7200

General health and safety communication with contractors *not* contracted with CH2M HILL is listed below. These procedures can also be applied to other third party communications (e.g., client personnel).

- Ask the contractor to brief CH2M HILL on the contractor's health and safety plan for how the plan affects CH2M HILL employees on the site.
- If acceptable to the client, communicate about health and safety directly with the contractor PM or other onsite contractor-designated representative. CH2M HILL employees are not to direct the details of the contractor's work or to advise on health and safety (e.g., how the contractor corrects unsafe conditions).
- If an observed hazard poses a risk to CH2M HILL personnel, notify the party controlling the work activity as soon as possible. Notify the project manager; the project manager will notify the client. Document oral notification in project records (i.e., the field logbook).
- If a hazardous condition endangering a CH2M HILL employee persists, inform the contractor and the project manager (the project manager will contact the client) that CH2M HILL cannot execute the assigned work until the hazard is mitigated.
- When an apparent imminent danger exists, orally warn the person(s) in danger and orally notify the contractor promptly. When an imminent danger involves a CH2M HILL employee, remove the employee and suspend CH2M HILL work immediately until the hazard has been mitigated. Inform the project manager and the contractor promptly.
- The SSC or the project manager must notify the client and CH2M HILL health and safety staff when (1) the contractor fails to remedy an unsafe condition affecting CH2M HILL personnel, (2) the contractor does not remedy the hazardous condition within a reasonable period of time, or (3) the contractor repeatedly creates the hazardous condition.

5 PERSONAL PROTECTIVE EQUIPMENT (PPE) (Reference CH2M HILL SOP HS-07, *Personal Protective Equipment*, HS-08, *Respiratory Protection*, Section 2 of the *Site Safety Notebook*)

5.1 PPE SPECIFICATIONS^a

Task	Level	Body	Head	Respirator ^b
General work uniform when no chemical exposure is anticipated	D	Work clothes; steel-toe, steel-shank leather work boots; work gloves	Hardhat ^c Safety glasses Ear protection ^d	None required
All tasks with potential for minimal contact with contaminated media	Modified D	COVERALLS: Uncoated Tyvek® BOOTS: Steel-toe, steel-shank chemical-resistant boots OR steel-toe, steel-shank leather work boots with outer rubber boot covers GLOVES: Inner surgical-style nitrile glove AND outer chemical-resistant nitrile glove.	Hardhat ^c Splash shield ^d Safety glasses Ear protection ^d	None required
All tasks if Level D air monitoring Action Levels in Table 6 are exceeded	C	COVERALLS: Polycoated Tyvek® BOOTS: Steel-toe, steel-shank chemical-resistant boots OR steel-toe, steel-shank leather work boots with outer rubber boot covers GLOVES: Inner surgical-style nitrile glove AND outer chemical-resistant nitrile glove.	Hardhat ^c Splash shield ^d Ear protection ^d Spectacle inserts	APR, full face, MSA Ultratwin or equivalent; with GME-H ^e cartridges or equivalent
NOT APPROVED	B	COVERALLS: Polycoated Tyvek® BOOTS: Steel toe, steel-shank chemical-resistant boots OR steel-toe, steel-shank leather work boots with outer rubber boot covers GLOVES: Inner surgical-style nitrile glove AND outer chemical-resistant nitrile glove.	Hardhat ^c Splash shield ^d Ear protection ^d Spectacle inserts	Positive-pressure demand self-contained breathing apparatus (SCBA): MSA Ultralite, or equivalent

^a Modifications are as indicated. CH2M HILL will provide PPE to only CH2M HILL employees.

^b No facial hair that would interfere with respirator fit is permitted.

^c Hardhat and splash-shield areas are to be determined by the SSC.

^d Ear protection should be worn while working around drill rigs or other noise-producing equipment or when conversations cannot be held at distances of 3 feet or less without shouting. Refer to Section 6 for other requirements.

^e The GME-H cartridge is the new standard-issue cartridge. Available stock of the previously standard GMC-H cartridges may be used for tasks covered by this plan.

5.2 REASONS FOR UPGRADING OR DOWNGRADING LEVEL OF PROTECTION

Upgrade*	Downgrade
<ul style="list-style-type: none"> Request from individual performing task. Change in work task that will increase contact or potential contact with hazardous materials. Occurrence or likely occurrence of gas or vapor emission Known or suspected presence of dermal hazards. Instrument action levels (Section 6) exceeded. 	<ul style="list-style-type: none"> New information indicating that situation is less hazardous than originally thought. Change in site conditions that decreases the hazard. Change in work task that will reduce contact with hazardous materials.

*Performing a task that requires an upgrade to a higher level of protection (e.g., level D to level C) is permitted only when the PPE requirements have been specified in Section 5 and an SSC who meets the requirements specified in subsection 4.1 is present

6 AIR MONITORING SPECIFICATIONS (Reference CH2M HILL SOP HS-06, *Air Monitoring*, and Section 2 of the *Site Safety Notebook*)

Instrument	Tasks	Action Levels ^a		Frequency ^b	Calibration
FID: OVA model 128 or equivalent	Monitor breathing zone during field observation tasks (Not required if PID is used)	0 - 1 ppm 1 - 5 ppm >5 ppm	Level D Level C Stop and evaluate.	Initially and periodically during task	Daily (minimum) and whenever H2 is recharged. Record in log book.
PID: OVM with 11.8 eV lamp or HNu with 11.7 eV lamp or equivalent	Monitor breathing zone during field observation tasks (Not required if FID is used)	0 - 1 ppm 1 - 5 ppm >5 ppm	Level D Level C Stop and evaluate.	Initially and periodically during task	Daily (minimum). Record in log book.
CGI: MSA model 260 or 261 or equivalent	Monitor breathing zone during field observation tasks	0-10% ^c LEL: No explosion hazard 10-25% ^c LEL: Potential explosion hazard >25% ^c LEL: Explosion hazard; evacuate or vent		When intrusive work is performed.	Daily (minimum). Record in log book.
Dust Monitor: Visual assessment	Dust generating tasks	No visual dust Visual dust	Level D Level C	When work areas are visibly dusty.	N/A

Note a: Action levels apply to sustained breathing-zone measurements above background.

Note b: The exact frequency of monitoring depends on field conditions and is to be determined by the SSC; generally, every 5 to 15 minutes is acceptable; more frequently may be appropriate. Monitoring results should be recorded. Documentation should include instrument and calibration information, time and measurement result, personnel monitored, and place/location where measurement is taken (e.g., "Breathing Zone/MW-3," "at surface/SB-2," etc.)

6.1 CALIBRATION SPECIFICATIONS

(Refer to the respective manufacturer's instructions for proper instrument-maintenance procedures)

Instrument	Gas	Span	Reading	Method
PID: HNU, 10.2 eV probe	100 ppm isobutylene	9.8 ± 2.0	55 ppm	1.5 lpm reg Tubing OR 0.25 lpm reg direct tubing
HNU, 11.7 eV probe		5.0 ± 2.0	68 ppm	
PID: OVM, 10.0 or 10.6 eV bulb	100 ppm isobutylene	RF = 0.55	55 ppm	1.5 lpm reg Tubing
OVM, 11.8 eV bulb		RF = 0.68	68 ppm	
PID: MiniRAE, 10.6 eV bulb	100 ppm isobutylene	CF=53	53 ppm ± 5 ppm	1.5 lpm REG T Tubing
PID: TVA 1000	100 ppm isobutylene	CF=0.55	55 ppm ± 5 ppm	1.5 lpm REG T Tubing
FID: OVA-128	100 ppm methane	3.0 ± 1.5	100 ppm	1.5 lpm reg T tubing
FID: TVA 1000	100 ppm methane	CF=1.00	100 ppm ± 10	1.5 lpm reg T tubing
CGI: MSA 260, 261, 360, or 361	0.75% pentane	N/A	50% LEL ± 5 % LEL	1.5 lpm reg direct tubing

6.2 AIR SAMPLING

Sampling may be required by other OSHA regulations where there may be exposure to certain contaminants. Air sampling typically is required when site contaminants include lead, cadmium, arsenic, asbestos, and certain volatile organic compounds. Contact the HSM immediately if these contaminants are encountered.

Method Description: Based on current site conditions, additional air sampling by CH2M HILL is not required at this time. If conditions change, contact the HSM.

7 DECONTAMINATION (REFERENCE CH2M HILL SOP HS-13, *DECONTAMINATION*)

The SSC must monitor the effectiveness of the decontamination procedures. Decontamination procedures found to be ineffective will be modified by the SSC.

7.1 DECONTAMINATION SPECIFICATIONS

Personnel	Sample Equipment	Heavy Equipment
<ul style="list-style-type: none">• Boot wash/rinse• Glove wash/rinse• Outer-glove removal• Body-suit removal• Inner-glove removal• Respirator removal• Hand wash/rinse• Face wash/rinse• Shower ASAP• PPE-disposal method: Disposal will be done by the remediation contractors• Water-disposal method: Disposal will be done by the remediation contractors	<ul style="list-style-type: none">• Wash/rinse equipment• Solvent-rinse equipment• Solvent-disposal method: Disposal will be done by the remediation contractors	No heavy equipment will be used by CH2M HILL.

7.2 DIAGRAM OF PERSONNEL-DECONTAMINATION LINE

No eating, drinking, or smoking is permitted in contaminated areas and in exclusion or decontamination zones. The SSC should establish areas for eating, drinking, and smoking. Contact lenses are not permitted in exclusion or decontamination zones.

Figure 7-1 illustrates a typical establishment of work zones, including the decontamination line. Work zones are to be modified by the SSC to accommodate task-specific requirements.

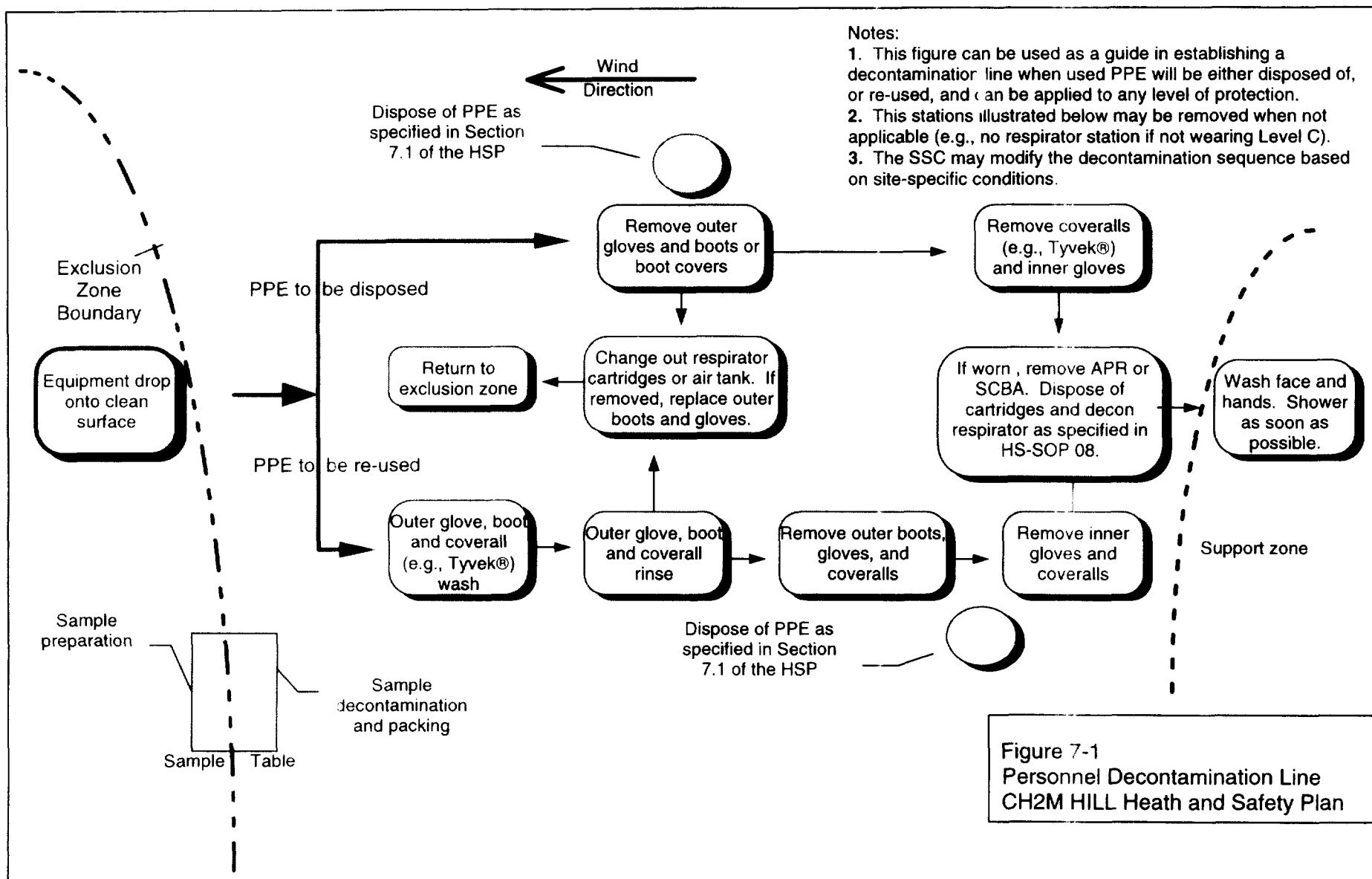
8 SPILL-CONTAINMENT PROCEDURES

Sorbent material will be maintained in the support zone. Incidental spills will be contained with sorbent and will be disposed of properly.

9 CONFINED-SPACE ENTRY

(Reference CH2M HILL SOP HS-17, *Confined Space Entry*)

CH2M HILL resident observers are not authorized to enter any confined spaces during oversight activities.



10 SITE-CONTROL PLAN

10.1 SITE-CONTROL PROCEDURES

- The CH2M HILL observer will act as the site safety coordinator (SSC) for CH2M HILL.
- The CH2M HILL SSC/observer will record all pertinent information when attending contractor safety briefings. The topics discussed will be recorded in a logbook.
- Post the OSHA job-site poster in a central and conspicuous location at sites where project field offices, trailers, or equipment storage boxes are established. Posters can be obtained by calling either 800/548-4776 or 800/999-9111.
- Field Trailers: Post "Exit" signs above exit doors, and post "Fire Extinguisher" signs above locations of extinguishers. Keep areas near exits and extinguishers clear.
- Determine wind direction.
- Establish work zones: support, decontamination, and exclusion zones. Delineate work zones with flags or cones as appropriate. Support zone should be upwind of the site.
- Establish decontamination procedures, including respirator-decontamination procedures, and test the procedures.
- Use access control at the entry and exit from each work zone.
- Store chemicals in appropriate containers.
- Make MSDSs available for onsite chemicals to which employees could be exposed.
- Establish onsite communication consisting of the following:
 - Line-of-sight and hand signals
 - Air horn
 - Two-way radio or cellular telephone if available
- Establish offsite communication.
- Establish and maintain the "buddy system."
- Establish procedures for disposing of material generated on the site.
- Initial air monitoring is conducted by the SSC in appropriate level of protection.
- The SSC/observer is to conduct periodic inspections of work practices to determine the effectiveness of this plan -- refer to CH2M HILL SOP 18, *Health and Safety Checklist*, or Section 4 of *Site Safety Notebook*. Deficiencies are to be noted, reported to the HSM, and corrected.

10.2 HAZWOPER COMPLIANCE PLAN (Reference CH2M HILL SOP HS-17, *Health and Safety Plans*)

This section outlines procedures to be followed when certain activities do not require 24- or 40-hour training. ***Note, prior approval from the HSM is required before these tasks are conducted on regulated hazardous waste sites.***

- Certain parts of the site work may be covered by state or federal Hazwoper standards and therefore require training and medical monitoring. Anticipated tasks must be included in subsection 2.2.1.
- Air sampling must confirm that there is no exposure to gases or vapors before non-Hazwoper-trained personnel are allowed on the site. Other data (e.g., soil) also must document that there is no potential for exposure. The HSM must approve the interpretation of these data. Refer to subsections 3.8 and 6.2 for contaminant data and air sampling requirements, respectively.
- Non-Hazwoper-trained personnel must be informed of the nature of the existing contamination and its locations, the limits of their access, and the emergency action plan for the site. Non-Hazwoper-trained personnel also must be trained in accordance with all other state and federal OSHA requirements, including 29 CFR 1910.1200 (HAZCOM). Refer to subsection 3.7.1 for hazard communication requirements.
- Air monitoring with direct-reading instruments conducted during regulated tasks also should be used to ensure that non-Hazwoper-trained personnel (e.g., in an adjacent area) are not exposed to volatile contaminants. Non-Hazwoper-trained personnel should be monitored whenever the belief is that there may be a possibility of exposure (e.g., change in site conditions), or at some reasonable frequency to confirm that there is no exposure. Refer to Section 6.1 for air monitoring requirements.
- Treatment system start-ups: Once a treatment system begins to pump and treat contaminated media, the site is, for the purposes of applying the Hazwoper standard, considered a treatment, storage, and disposal facility (TSDF). Therefore, once the system begins operation, only Hazwoper-trained personnel (minimum of 24 hours of training) will be permitted to enter the site. All non-Hazwoper-trained personnel must leave the site.

If Hazwoper-regulated tasks are conducted concurrently with nonregulated tasks, non-Hazwoper-trained subcontractors must be removed from areas of exposure. If non-Hazwoper-trained personnel remain on the site while a Hazwoper-regulated task is conducted, the contaminant/exposure area (exclusion zone) must be posted, non-Hazwoper-trained personnel must be reminded of the locations of restricted areas and the limits of their access, and real-time monitoring must be conducted. Non-Hazwoper-trained personnel at risk of exposure must be removed from the site until it can be demonstrated that there is no longer a potential for exposure to health and safety hazards.

11 EMERGENCY RESPONSE PLAN (REFERENCE CH2M HILL SOP HS-12, *EMERGENCY RESPONSE*)

11.1 PRE-EMERGENCY PLANNING

The SSC/observer performs the applicable pre-emergency planning tasks before starting field activities and coordinates emergency response with the facility and local emergency-service providers as appropriate.

- Review the facility emergency and contingency plans where applicable.
- Locate the nearest telephone; determine what onsite communication equipment is available (e.g., two-way radio, air horn)
- Identify and communicate chemical, safety, radiological, and biological hazards.
- Confirm and post emergency telephone numbers, evacuation routes, assembly areas, and route to hospital; communicate the information to onsite or replacement personnel.
- Post site map marked with locations of emergency equipment and supplies, and post OSHA job-site poster. The OSHA job-site poster is required at sites where project field offices, trailers, or equipment-storage boxes are established. Posters can be obtained by calling either 800/548-4776 or 800/999-9111.
- Field Trailers: Post "Exit" signs above exit doors, and post "Fire Extinguisher" signs above locations of extinguishers. Keep areas near exits and extinguishers clear.
- Review changed site conditions, onsite operations, and personnel availability in relation to emergency response procedures.
- Evaluate capabilities of local response teams where applicable.
- Where appropriate and acceptable to the client, inform emergency room and ambulance and emergency response teams of anticipated types of site emergencies.
- Designate one vehicle as the emergency vehicle; place hospital directions and map inside; keep keys in ignition during field activities.
- Inventory and check site emergency equipment, supplies, and potable water.
- Communicate emergency procedures for personnel injury, exposures, fires, explosions, chemical and vapor releases.
- Review notification procedures for contacting CH2M HILL's medical consultant and team member's occupational physician.
- Rehearse the emergency response plan once before site activities begin, including driving the route to the hospital.
- Brief new workers on the emergency response plan.
- The SSC will evaluate emergency response actions and initiate appropriate follow-up actions.

11.2 EMERGENCY EQUIPMENT AND SUPPLIES

The SSC should mark the locations of emergency equipment on the site map and should post the map

Emergency Equipment and Supplies	Location
20 lb. (or two 10-lb) fire extinguisher (A, B, and C classes)	Field Trailer
First aid kit	Field Trailer
Eye wash	Field Trailer
Potable water	Field Trailer
Bloodborne-pathogen kit	Field Trailer
Air horn	Field Trailer

11.3 EMERGENCY MEDICAL TREATMENT

- Notify appropriate emergency response authorities listed in sections 12 and 13 (e.g., 911).
 - During a time of no emergency, contact CH2M HILL's medical consultant for advice and guidance on medical treatment.
 - If applicable within the context of the observer role, the SSC/observer will assume charge during a medical emergency until the ambulance arrives or until the injured person is admitted to the emergency room. CH2M HILL will not assume charge over remedial contractors working for the Settling Defendants.
 - Prevent further injury.
 - Initiate first aid and CPR where feasible.
 - Get medical attention immediately.
 - Perform decontamination where feasible; lifesaving and first aid or medical treatment take priority.
 - Notify the field team leader and the project manager of the injury.
 - Make certain that the injured person is accompanied to the emergency room.
 - Notify the health and safety manager.
 - Notify the injured person's human resources department within 24 hours.
 - Prepare an incident report -- refer to CH2M HILL SOP 12, *Emergency Response and First Aid*, and Section 6 of *Site Safety Notebook*. Submit the report to the corporate director of health and safety and the corporate human resources department (COR) within 48 hours.
 - When contacting the medical consultant, state that you are calling about a CH2M HILL matter, and give your name, your telephone number, the name of the injured person, the extent of the injury or exposure, and the name and location of the medical facility where the injured person was taken.
-

11.4 NONEMERGENCY PROCEDURES

The procedures listed above may be applied to nonemergency incidents. Injuries and illnesses (including overexposure to contaminants) must be reported to Human Resources. If there is doubt about whether medical treatment is necessary, or if the injured person is reluctant to accept medical treatment, contact the CH2M HILL medical consultant.

- When contacting the medical consultant, state that the situation is a CH2M HILL matter, and give your name, your telephone number, the name of the injured person, the extent of the injury or exposure, and the name and location of the medical facility where the injured person was taken.
- Follow these procedures as appropriate.

11.5 INCIDENT RESPONSE

In fires, explosions, or chemical releases, actions to be taken include the following:

- Shut down CH2M HILL operations and evacuate the immediate work area.
- Account for personnel at the designated assembly area(s).
- Notify appropriate response personnel.
- Assess the need for site evacuation, and evacuate the site as warranted.

Instead of implementing a work-area evacuation, note that small fires or spills posing minimal safety or health hazards may be controlled.

11.6 EVACUATION

- Evacuation routes will be designated by the SSC before work begins.
- Onsite and offsite assembly points will be designated before work begins.
- Personnel will leave the exclusion zone and assemble at the onsite assembly point upon hearing the emergency signal for evacuation.
- Personnel will assemble at the offsite point upon hearing the emergency signal for a site evacuation.
- Within the limitations of the oversight role, the SSC/observer and a "buddy" will remain on the site after the site has been evacuated (if possible) to assist local responders and advise them of the nature and location of the incident.
- The SSC/observer accounts for all personnel in the onsite assembly zone.
- A person designated by the SSC/observer, before work begins will account for any CH2M HILL personnel at the offsite assembly area.
- The SSC/observer will write up the incident as soon as possible after it occurs and will submit a report to the corporate director of health and safety.

11.7 EVACUATION ROUTES AND ASSEMBLY POINTS

Refer to the site map in Section 1. Evacuation routes and assembly areas (and alternative routes and assembly areas) are specified on the site map.

11.8 EVACUATION SIGNALS

Signal	Meaning
CH2M HILL	
Grasping throat with hand	Emergency—help me.
Thumbs up	OK; understood.
Grasping buddy's wrist	Leave area now.
Continuous sounding of horn	Emergency; leave site now.

Client/Facility: Not Applicable

12 EMERGENCY RESPONSE

12.1 EMERGENCY RESPONSE TELEPHONE NUMBERS

SITE ADDRESS: 865 South, State Route 421,
Zionsville, Indiana

Phone:
Cellular Phone:

Police: Zionsville (County Dispatch)

Phone: (765) 482-1412 or 911*

Fire: Zionsville (County Dispatch)

Phone: (765) 482-1412 or 911*

Ambulance: Zionsville (County Dispatch)

Phone: (765) 482-1412 or 911*

Water:

Phone: Not Applicable

Gas:

Phone: Not Applicable

Electric:

Phone: (800) 521-2232

*When using a cellular phone outside the telephone's normal calling area, exercise caution in relying on the cellular phone to activate 911. When the caller is outside the normal calling area, the cellular service carrier should connect the caller with emergency services in the area where the call originated, but this may not occur. Telephone numbers of backup emergency services should be provided if a cellular phone is relied on to activate 911.

Hospital: St. Vincent Hospital

Phone - General Information: (317) 871-2345

Address: 2001 W. 86th Street, Indianapolis, Indiana

Phone - Emergency Room: (317) 338-2121

Route to Hospital: (Refer to Figure 12-1)

12.2 GOVERNMENT AGENCIES INVOLVED IN PROJECT

Federal Agency and Contact Name: U.S. Environmental Protection Agency (Mike McAteer)

Phone: (312) 886-4663

State Agency and Contact Name: Indiana Department of Environmental Management (Vince Epps)

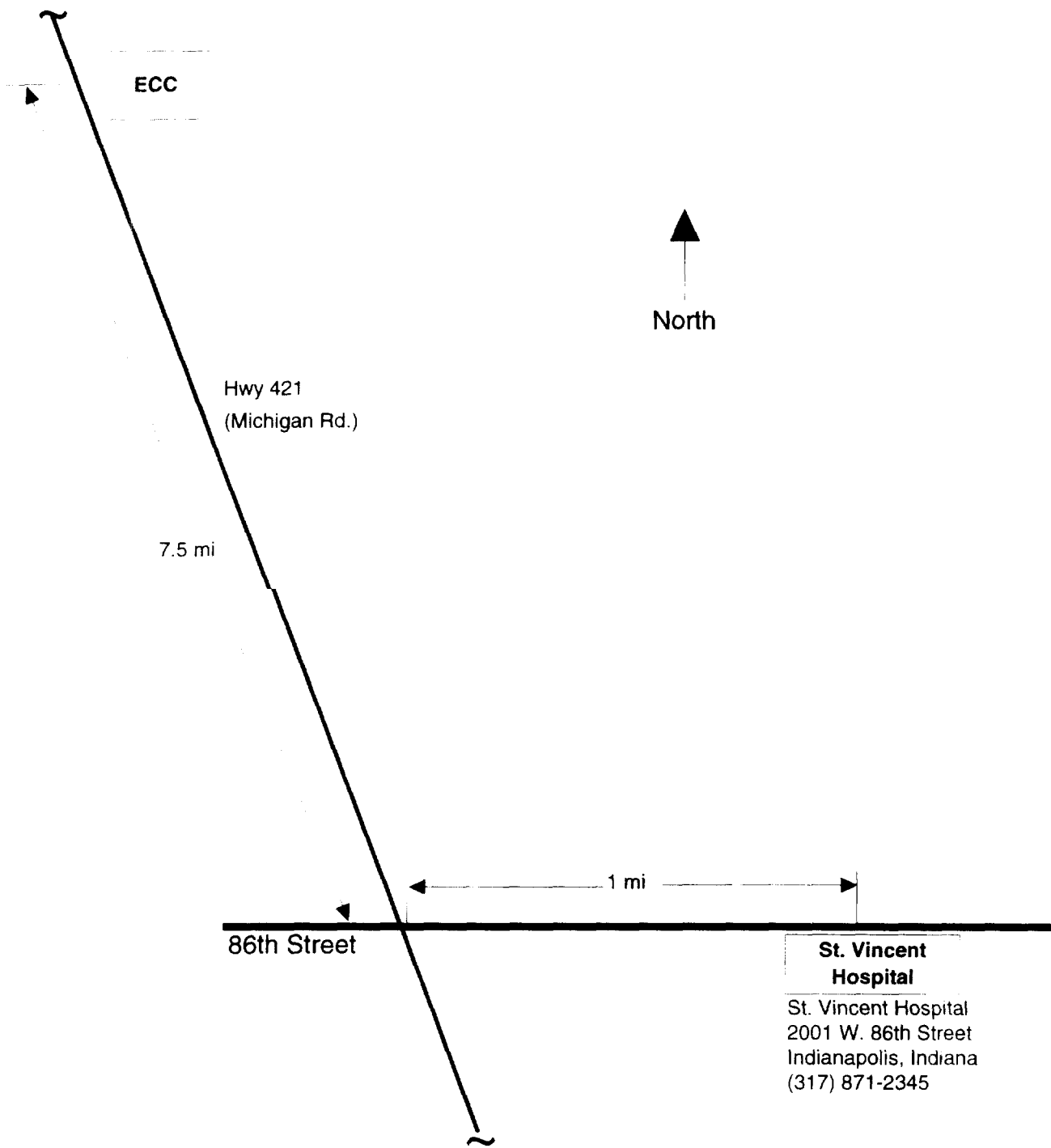
Phone: (317) 308-3368

Local Agency and contact Name: Boone County Health Department

Phone: (317) 482-3942

Contact the CH2M HILL site manager. Generally, the site manager will contact relevant government agencies.

Figure 12-1



Route to Hospital

13 EMERGENCY CONTACTS

If an injury occurs, notify the injured person's personnel office as soon as possible after obtaining medical attention for the injured person. Notification **MUST** be made within 24 hours of the injury.

CH2M HILL Medical Consultant

Dr. Elayne F. Theriault
Environmental Medical Resources, Inc.
Atlanta, Georgia
800/229-3674 OR 770/455-0818
(After-hours calls will be returned within 20 minutes.)

Occupational Physician (Regional or Local)

Occupational Medical Clinic
500 N. 19th Street
Milwaukee, Wisconsin 53233
414/961-7600

Corporate Director Health and Safety

Name: Mollie Netherland/SEA
Phone: 206/453-5005 ext. 5342

Site Safety Coordinator (SSC)

Name: See personnel list
Phone:

Medical and Training Administrator

Name: Cindy Carel/SEA
Phone: 206/453-5005

Regional Manager

Name: Patrick Klampe/MKE
Phone: 414/272-2426

Health and Safety Manager (HSM)

Name: Rich Rathnow/MKE
Phone: 414/272-2426

Site Manager

Name: Tim Harrison/CIN
Phone: 513/762-7605

Assistant Site Manager

Name: Bill Andrae/MKE
Phone: 414/272-2426

Radiation Health Manager (RHM)

Name: Dave McCormack/SEA
Phone: 206/453-5005 ext. 5417

Regional Human Resources Department

Name: Denise O'Brien-Snell
Phone: 414/272-2426

Client

Name: Mike McAteer/U.S. EPA
Phone: 312/886-4663

Corporate Human Resources Department

Name: Julie Zimmerman/COR
Phone: 303/771-0900

Federal Express Dangerous Goods Shipping

Phone: 800/238-5355

CH2M HILL Emergency Number for Shipping Dangerous Goods

Phone: 800/255-3924

Worker's Compensation and Auto Claims

GAB Business Services, Inc.
Phone: 800/747-7222 After hours 800/621-5410

Report fatalities AND report vehicular accidents involving pedestrians, motorcycles, or more than two cars.

14 APPROVAL

This site-specific health and safety plan has been written for use by CH2M HILL only. CH2M HILL claims no responsibility for its use by others unless that use has been specified and defined in project or contract documents. The plan is written for the specific site conditions, purposes, dates, and personnel specified and must be amended if those conditions change.

14.1 ORIGINAL PLAN

WRITTEN BY: David L. Shekoski/MKE

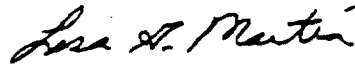
DATE: 7/30/97

APPROVED BY:



DATE: 8-6-97

CO-REVIEWER:



DATE: 8-5-97

14.2 REVISIONS

REVISIONS MADE BY: David L. Shekoski/MKE

DATE: 9/25/97

REVISIONS TO PLAN:

1. Document status changed from "Draft" to "Final"
2. Section 12.2 (Government Agencies involved in Project) - state agency contact name and phone number revised

REVISIONS APPROVED BY:



DATE:

9-25-97

15 DISTRIBUTION

Name	Office	Responsibility	Number of Copies
Jerri McCauslin	COR	Senior Program Assistant	1
Richard Rathnow	MKE	Health and Safety Manager/Approver	1
Tim Harrison	CIN	Site Manager	1
Bill Andrae	MKE	Assistant Site Manager	1
See Personnel List		Field Team Leader/Field Team	1
See Personnel List		Site Safety Coordinator	1
Mike McAteer	USEPA	Client Project manager	2

16 ATTACHMENTS

- Attachment 1:** Employee Signoff
Attachment 2: Applicable Material Safety Data Sheets

Employee Signoff	
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[illegible]

Attachment 2

Material Safety Data Sheets

MATERIAL SAFETY DATA SHEET
CFR 1910.1200 OSHA Hazard
Communication Rule Format

MINE SAFETY APPLIANCES COMPANY
600 Penn Center Boulevard
Pittsburgh, PA 15235
PHONE (412) 273-5000

PRODUCT IDENTITY

LABEL IDENTITY - MSA P/N 459945 Calibration Check Gas, 2% Methane in Air

CHEMICAL NAME - Methane, Oxygen, Nitrogen

ADDITIONAL IDENTITIES - MSA P/N 459945 Calibration Gas

FORMULA - CH_4 in Air

APPLICABLE CHEMICAL CONTENTS

	I	TLV
Methane (CAS 74-82-8)	2.0	None*
Air	Balance	None

Methane is a simple asphyxiant (ACGIH 1984-85)

NOTE: Gas Under Pressure, 250 PSIG at 70°F
Approx. 16 Liters at Atmospheric Pressure

PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE AND ODOR - Colorless, Odorless Gas

BOILING POINT - N/A

VAPOR PRESSURE - N/A

VAPOR DENSITY (AIR = 1) - <1

SOLUBILITY IN WATER - Methane

Oxygen

Nitrogen

— 9 cm^3 /100 ml (20°C)

— 3.2 cm^3 /100 ml (25°C)

— 2.3 cm^3 /100 ml (0°C)

SPECIFIC GRAVITY ($\text{H}_2\text{O} = 1$) - N/A

PERCENT VOLATILE BY VOLUME - N/A

PHYSICAL HAZARD INFORMATION

PHYSICAL HAZARD - Compressed Gas 250 PSIG at 70°F

CONDITIONS OR MATERIALS TO AVOID - None

FLASH POINT - N/A

(Methane) LEL (5.3%)

UEL (14.0%)

EXTINGUISHING MEDIA - This Calibration Gas Mixture is Not Flammable

SPECIAL FIRE FIGHTING PROCEDURES - See Next Item

UNUSUAL FIRE AND EXPLOSION HAZARDS - Gas Under Pressure, 250 PSIG at 70°F. Do Not Exceed 120°F.

HEALTH HAZARDS

HEALTH HAZARDS - Methane is a simple asphyxiant (ACGIH 1984-85)

ADDITIONAL SYMPTOMS OF EXPOSURE - None Known For 2% Methane

PRIMARY ROUTES OF ENTRY - Inhalation

TARGET ORGANS - Lungs

MEDICAL CONDITIONS GENERALLY RECOGNIZED AS BEING AGGRAVATED BY EXPOSURE - No Information

EXPOSURE LIMITS - None. Methane is a Simple Asphyxiant (ACGIH 1984-85). OSHA-None

CARCINOGENICITY DATA - Not Listed in NIOSH RTECS.

EMERGENCY AND FIRST AID PROCEDURES - None

SAFE HANDLING AND USE

HYGIENIC PRACTICES - Avoid Breathing Gas

TECTIVE MEASURES DURING REPAIR AND MAINTENANCE OF CONTAMINATED EQUIPMENT - Not Applicable

PROCEDURES FOR SPILL OR LEAK CLEANUP - Ventilate Area

WASTE DISPOSAL - Do not puncture or incinerate cylinder. Before discarding cylinder, slowly release contents to a safe exhaust.

STORAGE - Store in a cool, dry, well-ventilated area. Do not exceed 120°F.

CONTROL MEASURES

PERSONAL PROTECTIVE EQUIPMENT - Due to the limited amount of gas in the cylinder, and the release rate employed in instrument calibration, respiratory protection is not indicated under conditions of intended use.

ENGINEERING CONTROLS - Mechanical ventilation is suitable.

WORK PRACTICES - Avoid breathing gas. Use in well-ventilated areas. Follow the calibration procedure detailed in the MSA instruction manual provided with the instrument under calibration.

DATE OF PREPARATION - September 1985

The information provided herein has been compiled from sources believed to be reliable. However, Mine Safety Appliances Company makes no warranty as to the accuracy, completeness, sufficiency of the information and in no event will Mine Safety Appliances Company be responsible for loss or damage of any nature whatsoever resulting from use of the information.



Specialty Gas Material Safety Data Sheet

EMERGENCY PHONE (800) 523-8374 IN PENNSYLVANIA (800) 322-8082	PRODUCT NAME ISOBUTYLENE	CAS #115-11-7
AIR PRODUCTS AND CHEMICALS, INC. BOX 538 ALLENTOWN, PA 18105 (215) 481-8257	TRADE NAME AND SYNONYMS Isobutylene	
	CHEMICAL NAME AND SYNONYMS Isobutylene, Isobutene, 2-Methylpropene	
ISSUE DATE AND REVISIONS 04/78, 06/85	FORMULA (iso) C₄H₈	CHEMICAL FAMILY Alkene

HEALTH HAZARD DATA

TIME WEIGHTED AVERAGE EXPOSURE LIMIT <p style="text-align: center;">See last page.</p>
<p>SYMPTOMS OF EXPOSURE</p> <p>Inhalation: Moderate concentrations which exclude an adequate supply of oxygen to the lungs cause dizziness, drowsiness and eventual unconsciousness. It also has a very mild anesthetic effect which might cause lack of coordination or lessened mental alertness.</p> <p>Skin and Eye Contact: It is mildly irritating to mucous membranes. Due to its rapid rate of evaporation, Isobutylene can cause tissue freezing or frostbite on contact.</p>
<p>TOXICOLOGICAL PROPERTIES</p> <p>Isobutylene has a very mild anesthetic effect, however, the major health hazard is the exclusion of an adequate supply of oxygen to the lungs.</p> <p>Frostbite effects are a change in color of the skin to gray or white possibly followed by blistering.</p>
<p>RECOMMENDED FIRST AID TREATMENT</p> <p>PROMPT MEDICAL ATTENTION IS REQUIRED IN ALL CASES OF OVEREXPOSURE TO ISOBUTYLENE. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS AND MUST BE AWARE OF EXTREME FIRE AND EXPLOSION HAZARD.</p> <p>Inhalation: Move exposed personnel to an uncontaminated area. If not breathing, give artificial respiration, preferably mouth-to-mouth. If breathing is difficult, give oxygen. Medical assistance should be sought immediately.</p> <p>Skin Contact or Frostbite: Remove contaminated clothing and flush affected areas with lukewarm water. DO NOT USE HOT WATER. A physician should see the patient promptly if the cryogenic "burn" has caused blistering of the skin or deep tissue freezing.</p>

Information contained in this material safety data sheet is offered without charge for use by technically qualified personnel at their discretion and risk. All statements, technical information and recommendations contained herein are based on tests and data which we believe to be reliable, but the accuracy or completeness thereof is not guaranteed and no warranty of any kind is made with respect thereto. This information is not intended as a license to operate under or a recommendation to practice or infringe any patent of this Company or others covering any process, composition of matter or use.

Since the Company shall have no control of the use of the product described herein...

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES

Isobutylene is flammable over a wide range in air.

PHYSICAL DATA

BOILING POINT 19.6°F (−6.9°C)	LIQUID DENSITY AT BOILING POINT 39.1 lb/ft ³ (626 kg/m ³)
VAPOR PRESSURE @ 70°F (21.1°C) = 39 psia (269 kPa)	GAS DENSITY AT 70°F, 1 atm 0.148 lb/ft ³ (2.37 kg/m ³)
SOLUBILITY IN WATER Insoluble	FREEZING POINT −220.6°F (−140.3°C)
APPEARANCE AND ODOR Colorless gas with an unpleasant odor similar to that which is emitted when burning anthracite coal.	

FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used) See last page.	AUTO IGNITION TEMPERATURE 869°F (465°C)	FLAMMABLE LIMITS % BY VOLUME LEL 1.8 UEL 9.6
EXTINGUISHING MEDIA Water, carbon dioxide, dry chemical		ELECTRICAL CLASSIFICATION Class 1, Group not specified
SPECIAL FIRE FIGHTING PROCEDURES Keep cylinder(s) cool with water spray from a distance. If possible without risk, move cylinder(s) away from fire area. If possible without risk, stop the flow of gas to a fire. Allow gas fire to burn itself out. (Continued on last page.)		
UNUSUAL FIRE AND EXPLOSION HAZARDS Isobutylene is denser than air and can travel considerable distances to an ignition source and flash back. Cylinder(s) may explode or vent when exposed to fire.		

REACTIVITY DATA

STABILITY Unstable		CONDITIONS TO AVOID
Stable	X	
INCOMPATIBILITY (Materials to avoid) Oxidizers		
HAZARDOUS DECOMPOSITION PRODUCTS None		
HAZARDOUS POLYMERIZATION May Occur		CONDITIONS TO AVOID
Will Not Occur	X	

SPILL OR LEAK PROCEDURES**STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED**

Evacuate all personnel from affected area. Use appropriate protective equipment. If leak is in user's equipment, be certain to purge piping with an inert gas prior to attempting repairs. If leak is in container or container valve, call the "800" emergency phone number listed herein.

WASTE DISPOSAL METHOD

Federal, State and Local regulations regarding health and pollution should be followed in waste disposal. Contact Air Products for specific recommendations. Do not dispose of unused quantities.

(Continued on last page.)

SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type) Positive pressure air line with mask or self-contained breathing apparatus should be available for emergency use.

VENTILATION Hood with forced ventilation	LOCAL EXHAUST To prevent accumulation above the LEL	SPECIAL
	MECHANICAL (Gen.) In accordance with electrical codes	OTHER
PROTECTIVE GLOVES Plastic or rubber		
EYE PROTECTION Safety goggles or glasses		
OTHER PROTECTIVE EQUIPMENT Safety shoes, safety shower, eyewash "fountain."		

SPECIAL PRECAUTIONS*

SPECIAL LABELING INFORMATION

DOT Shipping Name: Liquefied petroleum gas DOT Hazard Class: Flammable gas

DOT Shipping Label: Flammable gas ID No.: UN 1075

SPECIAL HANDLING RECOMMENDATIONS

Use only in well-ventilated areas. Valve protection caps must remain in place unless container is secured with valve outlet piped to use point. Do not drag, slide or roll cylinders. Use a suitable hand truck for cylinder movement. Use a pressure reducing regulator when connecting cylinder to lower pressure (< 250 psig) piping or systems. Do not heat cylinder by any means to increase the discharge rate of product from the cylinder. Use a check valve or trap in the discharge line to prevent hazardous back flow into the cylinder.

For additional recommendations consult the Air Products Specialty Gas Catalog Safety and Technical Information Section or Compressed Gas Association Pamphlet P-1.

SPECIAL STORAGE RECOMMENDATIONS

Protect cylinders from physical damage. Store in cool, dry, well-ventilated area of non-combustible construction away from heavily trafficked areas and emergency exits. Do not allow the temperature where cylinders are stored to exceed 130°F (54°C). Cylinders should be stored upright and firmly secured to prevent falling or being knocked over. Full and empty cylinders should be segregated. Use a "first in-first out" inventory system to prevent full cylinders being stored for excessive periods of time. Post "No Smoking or Open Flames" signs in the storage or use area. There should be no sources of ignition in the storage or use area.

For additional recommendations consult the Air Products Specialty Gas Catalog Safety and Technical Information Section or Compressed Gas Association Pamphlet P-1.

SPECIAL PACKAGING RECOMMENDATIONS

Isobutylene is noncorrosive and may be used with any common structural material.

OTHER RECOMMENDATIONS OR PRECAUTIONS

Earth-ground and bond all lines and equipment associated with the isobutylene system. Electrical equipment should be non-sparking or explosion proof. Compressed gas cylinders should not be refilled except by qualified producers of compressed gases. Shipment of a compressed gas cylinder which has not been filled by the owner with his (written) consent is a violation of Federal Law (49CFR).

*Various Government agencies (i.e., Department of Transportation, Occupational Safety and Health Administration, Food and Drug Administration and others) may have specific regulations concerning the transportation, handling, storage or use of this product which will not be reflected in this data sheet. The customer should review these regulations to ensure that he is in full compliance.

TIME WEIGHTED AVERAGE EXPOSURE LIMIT (Continued)

Isobutylene is defined as a simple asphyxiant. Oxygen levels should be maintained at greater than 18 molar percent at normal atmospheric pressure which is equivalent to a partial pressure of 135 mm Hg. (ACGIH 1984-85)

FLASH POINT (Method Used) (Continued)

— 105°F (— 76°C) Closed Cup

SPECIAL FIRE FIGHTING PROCEDURES (Continued)

Ventilate low areas where flammable or explosive mixtures may form.

WASTE DISPOSAL METHOD (Continued)

Return the properly labeled shipping container to Air Products for disposal with valve(s) tightly closed, outlet seal(s) secured and valve protection cap in place. For emergency disposal assistance, call the "800" emergency phone number listed herein.

HAZ WASTE

MSD-1200

MAY 26 1986

069

MATERIAL SAFETY DATA SHEET
29 CFR 1910.1200 OSHA Hazard
Communication Rule Format

MINE SAFETY APPLIANCES COMPANY
600 Penn Center Boulevard
Pittsburgh, PA 15235
PHONE (412) 273-5000

PRODUCT IDENTITY

LABEL IDENTITY - MSA P/N 466193 Calibration Check Gas, 0.75% Pentane in air.
CHEMICAL NAME - Pentane, Oxygen, Nitrogen Mixture
ADDITIONAL IDENTITIES - MSA P/N 466193 Calibration Gas
FORMULA - C₅H₁₂ in Air

APPLICABLE CHEMICAL CONTENTS

	<u>%</u>	<u>TLV</u>
Pentane (CAS 109-66-0), STEEL 750 ppm (ACGIH 1984-85)	0.75	0.06%
Air	Balance	None

NOTE: Gas Under Pressure, 250 PSIG at 70°F
approx. 17 liters Gas at atmospheric Pressure

PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE AND ODOR - Colorless Gas, Faint Hydrocarbon Odor
BOILING POINT - N/A **SPECIFIC GRAVITY (H₂O = 1) -** N/A
VAPOR PRESSURE - N/A **PERCENT VOLATILE BY VOLUME -** N/A
VAPOR DENSITY (AIR = 1) - > 1
SOLUBILITY IN WATER - Pentane — 11 cm³/100 ml (16°C)
Oxygen — 3.2 cm³/100 ml (25°C)
Nitrogen — 2.3 cm³/100 ml (0°C)

MAY 26 1986

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MSA P/N 466193

PHYSICAL HAZARD INFORMATION

PHYSICAL HAZARD - Compressed Gas 250 PSIG at 70°F

CONDITIONS OR MATERIALS TO AVOID - None

FLASH POINT - N/A

(Pentane) LEL (1.4%)

UEL (8.0%)

EXTINGUISHING MEDIA - This Gas Mixture is Not Flammable

SPECIAL FIRE FIGHTING PROCEDURES - See Next Item

UNUSUAL FIRE AND EXPLOSION HAZARDS - Gas Under Pressure, 250 PSIG at 70°F. Do Not Exceed 120°F.

HEALTH HAZARDS

HEALTH HAZARDS - Pentane may be irritating to mucous membranes.

SIGNS AND SYMPTOMS OF EXPOSURE - Respiratory Tract Irritation

PRIMARY ROUTES OF ENTRY - Inhalation

TARGET ORGANS - Respiratory Tract

MSA P/N 459945

MEDICAL CONDITIONS GENERALLY RECOGNIZED AS BEING AGGRAVATED BY EXPOSURE - No Information

EXPOSURE LIMITS - None. Methane is a Simple Asphyxiant (ACGIH 1984-85). OSHA-None

CARCINOGENICITY DATA - Not Listed in NIOSH RTECS.

EMERGENCY AND FIRST AID PROCEDURES - None

SAFE HANDLING AND USE

HYGIENIC PRACTICES - Avoid Breathing Gas

PROTECTIVE MEASURES DURING REPAIR AND MAINTENANCE OF CONTAMINATED EQUIPMENT - Not Applicable

PROCEDURES FOR SPILL OR LEAK CLEANUP - Ventilate Area

MSA P/N 459945

WASTE DISPOSAL - Do not puncture or incinerate cylinder. Before discarding cylinder, slowly release contents to a safe exhaust.

STORAGE - Store in a cool, dry, well-ventilated area. Do not exceed 120°F.

CONTROL MEASURES

PERSONAL PROTECTIVE EQUIPMENT - Due to the limited amount of gas in the cylinder, and the low release rate employed in instrument calibration, respiratory protection is not indicated under conditions of intended use.

ENGINEERING CONTROLS - Mechanical ventilation is suitable.

WORK PRACTICES - Avoid breathing gas. Use in well-ventilated areas. Follow the calibration procedure detailed in the MSA instruction manual provided with the instrument under calibration.

DATE OF PREPARATION - September 1985

The information provided herein has been compiled from sources believed to be reliable. However, Mine Safety Appliances Company makes no warranty as to the accuracy, completeness, sufficiency of the information and in no event will Mine Safety Appliances Company be responsible for loss or damage of any nature whatsoever resulting from use of the information.



Genium Publishing Corporation

One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 30A
Hydrochloric Acid

Issued: 10/77

Revision: C, 9/92

Section 1. Material Identification

Hydrochloric Acid (HCl) Description: An aqueous solution of hydrogen chloride. Derived by dissolving hydrogen chloride gas in water at various concentrations. Hydrochloric acid is also formed as a byproduct from oxychlorination and/or oxyhydrochlorination of organic materials. Used in metal pickling and cleaning (boiler and heat exchange equipment scale removal), ore reduction, processing (corn syrup, hydrolyzing starch), dye and dye intermediate production, electroplating, leather tanning, in fertilizer, artificial silk, and paint pigment production, refining soaps and edible fats and oils, petroleum extraction, toilet bowl cleaners; as an alcohol denaturant, a chemical intermediate and solvent in organic synthesis, and in the photographic, textile, and rubber industries.

Other Designations: CAS No. 7647-01-0, Caswell No. 486, chlorohydric acid, Muriatic acid, spirits of salt.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*⁽⁷³⁾ for a suppliers list.

Cautions: Hydrochloric acid is highly corrosive and causes serious skin and eye burns as well as acute and chronic respiratory problems.

R 1
I 4
S 4
K 0

NFPA



HMS

H 2*

F 0

R 0

PPE†

* Chronic effects

† Sec. 8

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Section 2. Ingredients and Occupational Exposure Limits

Hydrochloric acid; ~38% (commercial), 20% ("azeotrope"). Trace impurities include ammonia, arsenic, iron, sulfate, free Cl⁻, and heavy metals.

1991 OSHA PEL
Ceiling: 5 ppm (7 mg/m³)

1992-93 ACGIH TLV
Ceiling: 5 ppm (7.5 mg/m³)

1990 IDLH Level
100 ppm

1990 DFG (Germany) MAK
Ceiling: 5 ppm (7 mg/m³)

1990 NIOSH REL
Ceiling: 5 ppm (7 mg/m³)

Category 1: local irritants
Peak Exposure Limit: 10 ppm,
5 min momentary value/8 per shift

1985-86 Toxicity Data*

Human, inhalation, LC₅₀: 1300 ppm/30 min; toxic effects not yet reviewed

Rabbit, oral, LD₅₀: 900 mg/kg; toxic effects not yet reviewed

Rat, inhalation, TC₅₀: 450 mg/m³/1 hr (1 day prior to pregnancy) produced fetotoxicity (except death) & specific developmental abnormalities (homeostasis).

Rabbit, eye: 100 mg rinse caused mild irritation

*See NIOSH, RTECS (MW4025000), for additional irritation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: -120.64 °F (-84.8 °C)*

Vapor Pressure: 4 atm at 64 °F (17.8 °C)

Vapor Density (Air = 1): 1.257

Surface Tension: 23 at 244.68 (118.16 °C)

Molecular Weight: 36.46

Odor Threshold: 0.1 to 5 ppm

Ionization Potential: 12.74 eV

Freezing Point: 1.1 °F (-17.14 °C) for 10.81%, -51.16 °F (-46.2 °C) for 31.24%

Density: 1.194 at -14.8 °F (-26 °C)

Water Solubility: Soluble, 823 g/L at 32 °F (0 °C); 561 g/L at 140 °F (60 °C).

Other Solubilities: Soluble in alcohol, benzene, and ether; insoluble in hydrocarbons.

pH: 1N (0.1), 0.1N (1.1), 0.01N (2.02), 0.001N (3.02), 0.0001N (4.01)

Refraction Index (1N solution): 1.34168 at 64.4 °F (18 °C/D)

Appearance and Odor: Colorless liquid that fumes in air and has a strong pungent odor. Can be slightly yellow from traces of iron, chlorine, or organic matter. Forms a constant boiling azeotrope at 20 % HCl, 108.58 °C and 760 mm Hg.

* Decomposes at 5239.6 °F (1782 °C).

Section 4. Fire and Explosion Data

Flash Point: Noncombustible

Autoignition Temperature: None reported

LEL: None reported*

UEL: None reported*

Extinguishing Media: Use extinguishing agents suitable for surrounding fire.

Unusual Fire or Explosion Hazards: *Extreme heat or contact with many metals liberates hydrogen gas which has explosion limits of 4 to 75%.

Special Fire-fighting Procedures: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing is *ineffective* for fires involving hydrochloric acid. Stay away from ends of tanks. Cool tanks with water spray until well after fire is out. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Hydrochloric acid has high thermal stability (decomposes at 3239.6 °F/1782 °C). Hazardous polymerization does not occur unless exposed to aldehydes or epoxides.

Chemical Incompatibilities: Polymerizes on contact with aldehydes or epoxides; attacks most metals (except mercury, silver, gold, platinum, tantalum, and some alloys), some plastics, rubber, and coatings; reacts explosively with alcohols + hydrogen cyanide, potassium permanganate, tetraselenium tetranitride; ignites on contact with fluorine, hexalithium disilicide, metal acetylides or carbides (cesium acetylide, rubidium acetylide); and is incompatible with acetic anhydride, 2-amino ethanol, ammonium hydroxide, calcium phosphide, chlorosulfonic acid, 1,1-difluoroethylene, ethylene diamine, ethylene imine, oleum, perchloric acid, β-propiolactone, propylene oxide, sodium hydroxide, silver perchlorate + carbon tetrachloride, sulfuric acid, uranium phosphide, acetate, calcium carbide, magnesium bromide, mercuric sulfate, and chlorine + dinitroaniline.

Conditions to Avoid: Avoid contact with incompatibles.

Hazardous Products of Decomposition: Thermal oxidative decomposition of HCl produces toxic chloride fumes and explosive hydrogen gas.

Section 6. Health Hazard Data

Carcinogenicity: The IARC⁽¹⁶⁴⁾, NTP⁽¹⁶⁹⁾ and OSHA⁽¹⁶⁴⁾ do not list HCl as a carcinogen.

Summary of Risks: HCl is a highly corrosive liquid and depending on concentration and duration of exposure, symptoms range from irritation to ulcerations and permanent injury. **Target Organs:** Eyes, skin, respiratory tract, and liver (in animals). **Primary Entry Routes:** Inhalation, skin and eye contact. **Medical Conditions Aggravated by Long-Term Exposure:** Respiratory disorders.

Continue on next page

Section 6. Health Hazard Data, continued

Acute Effects: Inhalation of vapors or mists is corrosive to the respiratory tract and can cause tracheal and bronchial epithelium necrosis (tissue death), cough, choking, ulceration. Liquid aspiration can cause pulmonary edema, lung collapse, emphysema and damage to the pulmonary blood vessels. Skin contact with HCl solutions causes burns and ulcerations. Permanent eye damage may result from splashes. Ingestion is unlikely but if it occurs, symptoms include gray tongue color, corrosion of mucous membranes, esophagus, and stomach, nausea, vomiting, intense thirst, diarrhea, difficulty swallowing, circulatory collapse and possible death. **Chronic Effects:** Repeated or prolonged exposure can cause dermatitis, conjunctivitis, gastritis, photosensitization, tooth erosion, and repeated exposure to mists from heated-metal pickling solutions can cause nose and gum bleeds, ulceration of oral or nasal mucosa, and "renders facial skin so tender that shaving is painful."⁽¹³³⁾

FIRST AID

Eyes: Do not allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** Quickly remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Treat skin with a 5% triethanolamine solution. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have that conscious and alert person drink 1 to 2 glasses of water to dilute. Do not induce vomiting!

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Consider a chest x-ray in acute overexposure. Gastric lavage with 5% sodium bicarbonate may be helpful.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Neutralize spills with crushed limestone, soda ash, lime, or sodium bicarbonate. After neutralizing, take up small spills with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable containers for disposal; flush large spills to containment area and reclaim (if possible) or await disposal. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** In soil, HCl will infiltrate moving faster in the presence of moisture. It may dissolve some soil matter, particularly those of a carbonate base will be neutralized to some degree and will be transported to groundwater. **Ecotoxicity Values:** Chronic plant toxicity = 100 ppm; injurious to irrigatable crops at 350 mg/L; trout, LC₁₀₀, 10 mg/L/24 hr shrimp, LC₅₀, 100 to 330 ppm/starfish, LC₅₀, 100 to 330 mg/L/48 hr; shore crab, LC₅₀, 240 mg/L/48 hr. **Disposal:** Neutralize to between 5.5 & 8.5 before disposal. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.23, 0.01N solution or higher): No. D002, Characteristic of corrosivity

Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 5000 lb (2270 kg) [* per CWA, Sec. 311 (b)(4)]

SARA Extremely Hazardous Substance (40 CFR 355), TPQ: Not listed

Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 50 ppm, use a cartridge respirator with acid gas cartridges, or any supplied-air respirator (SAR) or SCBA. For < 100 ppm, use any chemical cartridge respirator with a full facepiece and cartridge that protects against HCl inhalation, or any SAR or SCBA with a full facepiece. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. **Warning!** Air-purifying respirators do not protect workers in oxygen-deficient atmospheres. If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Polycarbonate, butyl rubber, polyvinyl chloride, and chlorinated polyethylene are recommended materials for PPE. Polyvinyl alcohol is not recommended. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.⁽¹⁰³⁾ **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes. Launder contaminated work clothing before wearing. Remove this material from your shoes and clean personal protective equipment. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Prevent physical damage to containers. Store in a cool, dry, well-ventilated area on a cement floor away from direct sunlight and heat sources. Use decanting pumps or pouring frames to minimize spillage during loading and unloading operations.

Engineering Controls: To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. HCl should be manufactured in closed systems. Pay close attention to leak detection. Aqueous scrubbers are used to control hydrogen chloride emissions from vent stacks and other sources. Workers shouldn't enter tanks previously containing HCl until they have been cleaned.

Administrative Controls: Consider preplacement and periodic medical exams of exposed workers with emphasis on the eyes, skin, and respiratory tract. Pulmonary function tests (FEV, FVC) are useful in determining lung disorders. Conduct difficult operations in fume hoods.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Hydrochloric acid, solution

DOT Hazard Class: 3

ID No.: UN1789

DOT Label: Corrosive

DOT Packing Group: II

Special provisions (172.102): A3, A6, B2, B15.

N41, T9, T27

Packaging Authorizations

a) Exceptions: 173.154

b) Non-bulk Packaging: 173.202

c) Bulk Packaging: 173.242

Quantity Limitations

a) Passenger, Aircraft, or Railcar: 1 L

b) Cargo Aircraft Only: 30 L

Vessel Stowage Requirements

a) Vessel Stowage: C

b) Other: 8

MSDS Collection References: 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 148, 149, 153, 163, 164, 167, 168, 171, 174, 180

Prepared by: M Gannon, BA; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: AC Darlington, MPH, MD

**Section 1. Material Identification**

39

Nitric Acid (HNO₃) Description: A solution of nitrogen dioxide in water commercially available in many concentrations. Derived by oxidation of ammonia by catalytic process (heated platinum catalyst); or by direct synthesis, combining atmospheric nitrogen and oxygen in an electric arc (an expensive process, thus largely abandoned). HNO₃ is usually found in conjunction with nitrogen dioxide, which is considered more hazardous. Used in fertilizer production (ammonium nitrate), in photoengraving, steel etching, explosives (TNT, nitroglycerin, trinitrophenol); manufacture of metallic nitrates, sulfuric acid, aqua regia and oxalic acid, jewelry, various dyes and dyestuffs, pharmaceuticals; as a laboratory reagent, in metallurgy (*mainly* as a pickling agent) and the printing industry.

Other Designations: CAS No. 7697-37-2, aqua fortis, aqua regia, azotic acid, engravers nitrate, hydrogen nitrate, red fuming nitric acid (RFNA), white fuming nitric acid (WFNA).

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*⁽⁷³⁾ for suppliers list.

Cautions: Nitric acid is a corrosive, strong oxidizer that causes irritation or severe burns to the skin, eyes, and respiratory tract. Exposures to high levels of the concentrated acid can be fatal. Increases the flammability of combustibles. Use extreme caution when handling HNO₃.

R	2	HMIS		NFPA
I	4	H	3*	
S	4	F	0	
K	0	R	1	
		PPE**		
				Fuming nitric acid
				0 3 1 ox
R	2	HMIS		
I	4	H	3*	
S	4	F	0	
K	0	R	1	
		PPE**		
				> 40% nitric acid
				0 3 0 ox
R	2	HMIS		
I	3	H	3*	
S	3	F	0	
K	0	R	0	
		PPE**		
				≤ 40% nitric acid
				0 3 0 -

* Chronic effects ** See Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Nitric acid, various %. Commercially available in nearly all concentrations; most common are 56 and 68%. RFNA (85%), WFNA (97.5%).

1991 OSHA PELs8-hr TWA: 2 ppm (5 mg/m³)15-min STEL: 4 ppm (10 mg/m³)**1990 IDLH Level**

100 ppm

1990 NIOSH REL8-hr TWA: 2 ppm (5 mg/m³)15-min STEL: 4 ppm (10 mg/m³)**1992-93 ACGIH TLVs**TWA: 2 ppm (5.2 mg/m³)STEL: 4 ppm (10 mg/m³)**1990 DFG (Germany) MAK**2 ppm (5 mg/m³)

Category I: local irritants

Peak Exposure Limit: 2 ppm

5 min momentary value, 8 per shift

1985-86 Toxicity Data*Man, unreported route, LD₅₀: 110 mg/kg; toxic effects not yet reviewedRat, oral, TD₅₀: 5275 g/kg administered from 1 to 21 days of pregnancy caused post-implantation mortality and specific developmental abnormalities of the musculoskeletal system.Rat, inhalation, LC₅₀: 67 ppm (NO₂)/4 hr; toxic effects not yet reviewed

* See NIOSH, RTECS [QU5775000 (nitric acid), QU5900000 (RFNA), QU6000000 (WFNA)] , for additional reproductive and toxicity data.

Section 3. Physical Data**Boiling Point:** 186.8 °F (86 °C)**Melting Point:** -43.6 °F (-42 °C)**Vapor Pressure:** 67% HNO₃ = 6.8 mm Hg at 68 °F (20 °C); 95 to 98% = 113 at 100.4 °F (38 °C)**Saturated Vapor Density (Air = 1.2 kg/m³):** 1.212 kg/m³ or 0.0757 lb/ft³ (67 % HNO₃)**pH:** 1**Molecular Weight:** 63.02**Density:** 1.50269 at 77/39.2 °F (25/4 °C)**Water Solubility:** Soluble (releases heat)**Ionization Potential:** 11.95 eV

Appearance and Odor: Transparent, clear to yellow, fuming liquid with an acrid, suffocating odor which darkens to a brownish color on aging and exposure to light. "Fuming" nitric acid is red-brown in color.

Section 4. Fire and Explosion Data**Flash Point:** Noncombustible**Autoignition Temperature:** Noncombustible**LEL:** None reported**UEL:** None reported

Extinguishing Media: For small fires (< 40% HNO₃), use dry chemical, carbon dioxide (CO₂), water spray, or regular foam. For large fires, use water spray, fog, or regular foam. For small fires (> 40% HNO₃), use water spray, dry chemical, or soda ash. For large fires, flood area with water (*do not get inside HNO₃ containers*). Apply water from as far a distance as possible.

Unusual Fire or Explosion Hazards: HNO₃ is noncombustible but is an oxidizer which increases fire involving combustibles and can initiate an explosion. It releases flammable hydrogen gas in contact with many metals.

Special Fire-fighting Procedures: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing is not effective for fires involving nitric acid. Acid-resistant clothing is needed. Apply cooling water to sides of containers until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from area and let fire burn. *Do not release runoff from fire control methods to sewers or waterways.*

Section 5. Reactivity Data

Stability/Polymerization: Nitric acid decomposes in air and in contact with light and organic matter. Hazardous polymerization cannot occur.

Chemical Incompatibilities: Nitric acid reacts explosively with combustibles, organics or readily oxidizable materials such as wood, turpentine, metal powder and hydrogen sulfide, carbides, cyanides, and alkalis; causes spattering with strong bases; is corrosive to paper, cloth and most metals (except aluminum, gold, platinum, thorium, and tantalum. Will also attack some forms of plastics, rubber, and coatings. There are at least 150 chemicals and chemical combinations which are incompatible with nitric acid. HNO₃ reacts with water to produce heat and toxic corrosive fumes. Refer to *Genium* references 126 and 159 for further detail. **Conditions to Avoid:** Avoid exposure to moisture, heat, and incompatibles.

Hazardous Decomposition Products: Thermal oxidative decomposition of HNO₃ produces nitrogen peroxide and toxic, irritating nitrogen oxides.

Section 6. Health Hazards Data

Carcinogenicity: The IARC,⁽¹⁶⁴⁾ NTP,⁽¹⁶⁹⁾ and OSHA⁽¹⁶⁴⁾ do not list nitric acid as a carcinogen.

Summary of Risks: Nitric acid is very corrosive to the skin, eyes, digestive and respiratory tract or any tissue it comes in contact with. 58 to 68% (nitric acid) vapors are moderately irritating and can't be tolerated at high concentrations. 95% (nitric acid) vapors cause severe irritation at very low levels and the liquid causes 2nd and 3rd degree burns on short contact with skin or eyes. Vapor inhalation may cause pulmonary edema (fluid in lungs) leading to death. HNO₃ vapor or mist can slowly corrode teeth when chronically exposed. **Medical Conditions Aggravated by Long-Term Exposure:** Chronic respiratory diseases. **Target Organs:** Eyes, skin, respiratory tract, teeth.

Continue on next page

Section 6. Health Hazard Data, continued

Primary Entry Routes: Inhalation, ingestion, skin and eye contact. **Acute Effects:** Inhalation symptoms may take several hours and include throat and nose irritation, cough, chest pain, difficulty breathing, salivation, giddiness, nausea, muscular weakness, ulceration of nasal mucous membranes, pulmonary edema, and chemical pneumonia. Skin contact is moderately irritating to severely corrosive depending on % of nitric acid. Burns may penetrate deeply causing ulcers. Skin may be stained yellowish brown. Dilute solutions cause irritation and tend to harden the epithelium (outer skin layer) without destroying it. HNO_3 liquid causes yellow discoloration of the eyes and severe burns which may result in permanent damage, i.e., sight loss. Ingestion produces immediate pain and digestive tract burns followed by throat swelling, convulsions, risk of stomach perforation (causing a rigid abdomen) and possible coma. **Chronic Effects:** Repeated inhalation of low concentrations may cause chronic bronchitis, tooth erosion, and/or appetite loss. Repeated exposure to NO_x such as produced by thermal decomposition of HNO_3 is implicated in chronic lung diseases.

FIRST AID

Eyes: Do not allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** Quickly remove contaminated clothing (do not force removal if stuck to skin). Rinse with flooding amounts of water for at least 15 min. Apply a 5% triethanolamine solution to affected area. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have that conscious and alert person drink 1 to 2 glasses of water to dilute followed by lime milk or milk of magnesia. Do not induce vomiting. Do not give sodium bicarbonate or attempt to neutralize the acid.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Observe for several hours since symptoms such as pulmonary edema may be delayed.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Immediately notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Cleanup personnel should wear fully-encapsulating vapor-protective clothing. Use water spray to cool and disperse vapor. Keep combustibles away from spilled material. For small spills, take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in dry containers for disposal. For large spill, flush with water to containment area and neutralize with agricultural (slaked) lime, sodium bicarbonate, crushed limestone, soda ash, or lime. Report any release in excess of 1000 lb. Control runoff and dike for disposal. Follow applicable OSHA regulations (29 CFR 1910.120).

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a SARA Toxic Chemical (40 CFR 372.65)

Listed as a SARA Extremely Hazardous Substance (40 CFR 355), TPQ: 1000 lb

Listed as a RCRA Hazardous Waste (40 CFR 261.22): No. D001, Characteristic of corrosivity

Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg) [* per CWA, Sec. 311(b)(4)]

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Listed as a Process Safety Hazardous Chemical (29 CFR 1910.119), TQ: 500 lb

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For < 50 ppm, use any supplied-air respirator operated in a continuous-flow mode. For < 100 ppm, use any supplied-air respirator or SCBA with a full facepiece. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. **Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.** If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear acid-proof gloves, boots, aprons, and gauntlets to prevent skin contact. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.⁽¹⁰³⁾ **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes. Launder contaminated work clothing before wearing. Remove this material from your shoes and clean personal protective equipment. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Prevent physical damage to containers. Store in aluminum, stainless steel, or glass containers on a cement floor in a cool, dry, well-ventilated area away from incompatibles (Sec. 5). Dike around storage tanks with large kirbs or stills to retain the acid in event of leakage. Keep neutralization agents on hand and install a fire hydrant in storage area. (See NFPA Code 43A). **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. **Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers that emphasize the eyes, skin, respiratory tract and teeth. Pulmonary function tests (FEV< FVC) are helpful. Educate workers about the hazardous properties of nitric acid.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: * , † , § , ¶ , ψ , φ

DOT Hazard Class: 8

ID No.: UN1826 (*†), UN1796 (†§), UN2031 (¶ψ), UN2032 (φ)

DOT Packing Group: I (†§¶φ), II (*†ψ)

DOT Packaging Label: Corrosive (*†ψ), Corrosive, Oxidizer (†§), Corrosive, Oxidizer, Poison (φ)

Special Provisions (172.102): B2, T12, T27 (*); T12, T27 (†); B2, T12, T27 (‡); T12, T27 (§); B12, B53, T9, T27 (¶); B2, B12, B53, T9, T27 (ψ); 2, B9, B32, B74, T38, T43, T45(φ)

* Nitrating acid mixtures spent, < 50% HNO_3

† Nitrating acid mixtures spent, > 50% HNO_3

‡ Nitrating acid mixtures, < 50% HNO_3

§ Nitrating acid mixtures, > 50% HNO_3

¶ Nitric acid other than red fuming, > 70% HNO_3

ψ Nitric acid other than red fuming, < 70% HNO_3

φ Nitric acid, red fuming.

Packaging Authorizations

a) Exceptions: None

b) Non-bulk Packaging: 173.158 (*†§¶ψ), 173.227 (φ)

c) Bulk Packaging: 173.242 (*†ψ), 173.243 (†§¶), 173.244(φ)

Quantity limitations

a) Passenger Aircraft or Railcar: Forbidden

b) Cargo Aircraft Only: 30L (*†ψ), 2.5L (†§¶), Forbidden (φ)

Vessel Stowage Requirements

a) Vessel stowage: D

b) Other: 40(*) , 40, 66, 89 (†); 40 (‡); 40, 66, 89 (§); 110, 111 (¶); 110, 111 (ψ); 40, 66, 74, 89, 90, 95 (φ)

ASDS Collection References: 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 136, 139, 140, 148, 149, 153, 159, 162, 163, 164, 167, 168, 171, 174, 175

Prepared by: M Gannon, BA; **Industrial Hygiene Review:** PA Rov, MPH, CH; **Medical Review:** W Silverman, MD

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aldrich chemical co.

P.O. Box 355, Milwaukee, Wisconsin 53201 USA

Telephone (414) 273-3850
TWX: (910) 262 3052 Aldrichem MI
Telex: 26 843 Aldrich MI
FAX: (414) 273-4979

ATTN: SAFETY DIRECTOR
CH2M HILL INC
PO BOX 4400
RESTON VA 22090
KIRK THOMPSON

DATE: 11/06/87
CUST # 924476 P.O. # W6530

M A T E R I A L S A F E T Y D A T A S H E E T PAGE: 1

IDENTIFICATION

PRODUCT # 15490-3 NAME: METHYL ALCOHOL, 99.9%, SPECTROPHOTOMETRIC GRADE
CAS # 67-56-1

TOXICITY HAZARDS

RTECS # PC1400000

METHANOL

IRRITATION DATA

SKN-RBT 500 MG/24H MDD

EYE-RBT 40 MG MDD

28ZPAK -,33,72

UCDS# 3/24/70

TOXICITY DATA

ORL-HMN LD50:428 MG/KG

ORL-HMN LD50:143 MG/KG

UNR-MAN LD50:858 MG/KG

ORL-RAT LD50:5628 MG/KG

IHL-RAT LC50:64000 PPM/4H

IPR-RAT LD50:7529 MG/KG

IVN-RAT LD50:2131 MG/KG

ORL-MUS LD50:7300 MG/KG

IPR-MUS LD50:10765 MG/KG

SCJ-MUS LD50:9800 MG/KG

IVN-MUS LD50:4710 MG/KG

SKN-RBT LD50:15800 MG/KG

IPR-RBT LD50:1926 MG/KG

IVN-RBT LD50:8907 MG/KG

IPR-GPG LD50:3556 MG/KG

IPR-HAM LD50:9555 MG/KG

NPIRI# 1,74,74

34ZLAG -,382,69

85DCAI 2,73,70

GTPZAB 19(11),27,75

NPIRI# 1,74,74

EVHPAZ 61,321,85

EVHPAZ 61,321,85

TXCYAC 25,271,82

EVHPAZ 61,321,85

TXAPA9 18,185,71

EVHPAZ 61,321,85

NPIRI# 1,74,74

EVHPAZ 61,321,85

EVHPAZ 61,321,85

EVHPAZ 61,321,85

EVHPAZ 61,321,85

REVIEWS, STANDARDS, AND REGULATIONS

ACGIH TLV-TWA 200 PPM; STEL 250 PPM (SKIN) 85INA8 5,372,86

MSHA STANDARD-AIR:TWA 200 PPM (260 MG/43) (SKIN) DTLVS# 3,155,71

OSHA STANDARD-AIR:TWA 200 PPM FEREAC 39,23540,74

NIOSH REL TO METHYL ALCOHOL-AIR:TWA 200 PPM;CL 800 PPM/15M MMWR#

34(15),215,85

EPA GENETOX PROGRAM 1986, NEGATIVE: SHE-CLONAL ASSAY; CELL TRANSFORM.-

SA7/SHE

EPA GENETOX PROGRAM 1986, NEGATIVE: N CRASSA-ANEUPLOIDY; IN VITRO SCE-

NONHUMAN

EPA TSCA CHEMICAL INVENTORY, 1986

EPA TSCA SECTION 8(E) STATUS REPORT 9EHJ-0378-0108

EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, DECEMBER 1986

NIOSH ANALYTICAL METHODS: SEE METHANOL, 2000

MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420.

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ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION



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P.O. Box 355, Milwaukee, Wisconsin 53201 USA

Telephone: (414) 273-3850
TWX: (910) 262-3052 Aldrichem MI
Telex: 26 843 Aldrich MI
FAX: (414) 273-4979

M A T E R I A L S A F E T Y D A T A S H E E T P A G E :

CATALOG # 15490-3 NAME: METHYL ALCOHOL, 99.9%, SPECTROPHOTOMETRIC GRADE

----- HEALTH HAZARD DATA -----

ACUTE EFFECTS

MAY BE FATAL IF SWALLOWED.
HARMFUL IF INHALED OR ABSORBED THROUGH SKIN.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING,
WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND
VOMITING.

EXPOSURE CAN CAUSE:

DAMAGE TO THE EYES
DAMAGE TO THE LIVER
DAMAGE TO THE HEART
DAMAGE TO THE KIDNEYS
GASTROINTESTINAL DISTURBANCES
MAY CAUSE CONVULSIONS.

FIRST AID

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS
AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED
CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS
WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL
RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
DISCARD CONTAMINATED CLOTHING AND SHOES.

ADDITIONAL INFORMATION

METHYL ALCOHOL MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED. CANNOT
BE MADE NON-POISONOUS.

----- PHYSICAL DATA -----

MELTING POINT: -98 C
BOILING POINT: 64.6 C
SPECIFIC GRAVITY: 0.791
VAPOR DENSITY: 1.1
VAPOR PRESSURE: 97.68 MM @ 20 C

----- FIRE AND EXPLOSION HAZARD DATA -----

AUTO IGNITION TEMP.: 725 F
LOWER EXPLOSION LEVEL: 6.0%
UPPER EXPLOSION LEVEL: 36.0%
FLASH POINT: 52 F

EXTINGUISHING MEDIA

CARBON DIOXIDE, DRY CHEMICAL POWDER, ALCOHOL OR POLYMER FOAM.

SPECIAL FIRE FIGHTING PROCEDURES

WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO
PREVENT CONTACT WITH SKIN AND EYES.

UNUSUAL FIRE AND EXPLOSION HAZARDS

EXTREMELY FLAMMABLE.
VAPOR MAY TRAVEL CONSIDERABLE DISTANCE TO SOURCE OF IGNITION AND
FLASH BACK.

----- REACTIVITY DATA -----

INCOMPATIBILITIES

ACIDS
ACID CHLORIDES
ACID ANHYDRIDES
OXIDIZING AGENTS
REDUCING AGENTS
ALKALI METALS



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P.O. Box 355, Milwaukee, Wisconsin 53201 USA

Telephone: (414) 273-3850
TWX: (910) 262-3052 Aldrichem MI
Telex: 26 843 Aldrich MI
FAX: (414) 273-4979

M A T E R I A L S A F E T Y D A T A S H E E T PAGE:

CATALOG # 15490-3

NAME: METHYL ALCOHOL, 99.9%, SPECTROPHOTOMETRIC GRADE

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS

TOXIC FUMES OF:

CARBON MONOXIDE, CARBON DIOXIDE

----- SPILL OR LEAK PROCEDURES -----

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED

EVACUATE AREA.

SHUT OFF ALL SOURCES OF IGNITION.

WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.

COVER WITH DRY-LIME, SAND, OR SODA ASH. PLACE IN COVERED CONTAINERS

USING NON-SPARKING TOOLS AND TRANSPORT OUTDOORS.

VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

WASTE DISPOSAL METHOD

BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER BUT EXERT EXTRA CARE IN IGNITING AS THIS MATERIAL IS HIGHLY FLAMMABLE.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

--- PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE ---

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.

MECHANICAL EXHAUST REQUIRED.

SAFETY SHOWER AND EYE BATH.

DO NOT BREATHE VAPOR.

AVOID CONTACT WITH EYES, SKIN AND CLOTHING.

AVOID PROLONGED OR REPEATED EXPOSURE.

DO NOT USE IF SKIN IS CUT OR SCRATCHED. WASH THOROUGHLY AFTER HANDLING.

POISON.

KEEP TIGHTLY CLOSED.

KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAME.

HYGROSCOPIC.

STORE IN A COOL DRY PLACE.

----- ADDITIONAL PRECAUTIONS AND COMMENTS -----

NOT APPLICABLE

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT BUT DOES NOT PURPORT TO BE ALL INCLUSIVE AND SHALL BE USED ONLY AS A GUIDE. ALDRICH SHALL NOT BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM HANDLING OR FROM CONTACT WITH THE ABOVE PRODUCT. SEE REVERSE SIDE OF INVOICE OR PACKING SLIP FOR ADDITIONAL TERMS AND CONDITIONS OF SALE.

Belgium
Aldrich Chemical Co. S.A.
Bel. Lambertstraat 140 B-1150
8100 Brussels
Telephone: 02 7478750
Telex: 82302 Aldrich B
Fax: 02 747 87 16

France
Aldrich Chimie S.A.
27, Fosse des Filles
F-67000 Strasbourg
Telephone: 86 32 72 10
Telex: 990018 Aldrich F
Fax: 86 32 72 62

Japan
Aldrich Japan
Kanda Bldg. Shinjuku
10 Kanda Shinjuku
Chiyoda-ku, Tokyo
Telephone: 03 3276 0155
Fax: 03 3276 0157

United Kingdom
Aldrich Chemical Co. Ltd.
The Old Brickyard, New Road
Gillingham, Dorset SP9 8UL
Telephone: 07476 1211
Telex: 311736 Aldrich G
Fax: 07476 1219

West Germany
Aldrich Chemie GmbH & Co. KG
D-7624 Steinheim
Telephone: 071329 67 0
Telex: 714636 Aldrich D
Fax: 071329 67 39

MATERIAL SAFETY DATA SHEET

(Essentially Similar to Form MSDS-2)

MSA P/N 34337

SECTION I

PRODUCT NAME	MSA CLEANER-SANITIZER II		
MANUFACTURER	Mine Safety Appliances Company 600 Penn Center Boulevard Pittsburgh, PA 15235	FORMULA CODE	8599-03
		COMPLETED BY	L. P. Dewosky
		TITLE	Mgr. Product Safety
EMERGENCY PHONE NO.	412-273-5500	DATE	6/9/83

SECTION II - INGREDIENTS

	CAS NUMBER	WEIGHT, %
ACTIVE INGREDIENTS:		
		54.7
SODIUM CARBONATE	497-19-8	42.2
TRISODIUM PHOSPHATE	7601-34-9	10.0
ALKYL (C14, 50%; C12, 40%; C16, 10%)		
DIMETHYL BENZYL AMMONIUM CHLORIDES	119-08-2	2.5
INERT INGREDIENTS:		
		45.3
SODIUM TRIPOLYPHOSPHATE	7758-29-4	
SODIUM BICARBONATE	144-35-8	
WATER	7732-18-5	
ISOMERIC LINEAR ALCOHOLS (C11-C15)		
POLYETHOXY ETHANOLS	68131-40-8*	
ETHANOL	64-17-5	
ISOBORNYL ACETATE	125-12-2	

SECTION III - PHYSICAL DATA

BOILING POINT (°F)	NA	SPECIFIC GRAVITY (20°C=1)	0.8
VAPOR PRESSURE (mm Hg)	NA	%VOLATILE BY VOLUME	NA
VAPOR DENSITY (AIR=1)	NA	EVAPORATION RATE (_____ = 1)	NA
SOLUBILITY IN WATER	30%	IN 1% AQUEOUS SOLUTION	9.5 - 10
APPEARANCE AND ODOR	FRAGRANT BLEND OF WHITE POWDERS		

SECTION IV - FIRE AND EXPLOSION DATA

FLASH POINT (Method used)	NO FLASH TO 240 F	FLAMMABLE LIMITS	LC	NA	UC	NA
EXTINGUISHING MEDIA	WATER SPRAY (FOG), FOAM, DRY CHEMICAL, CARBON DIOXIDE					
SPECIAL FIRE FIGHTING PROCEDURES	BLANKET FIRE WITH EXTINGUISHING MEDIUM					
HAZARDOUS REACTION	PRODUCT IS NONREACTIVE AND DOES NOT READILY SUPPORT					

SKIN CONTACT WITH POWDER MAY CAUSE BURNS. FLUSH AFFECTED AREA WITH CLEAN WATER.

EYE CONTACT WITH POWDER MAY CAUSE CORNEAL BURNS. AVOID RUBBING EYES BECAUSE WATER INSOLUBLE PARTICLES MAY SCRATCH CORNEA. IMMEDIATELY FLUSH EYES WITH CLEAN WATER WHILE HOLDING EYELIDS APART. CONTINUE FLUSHING FOR AT LEAST 15 MINUTES OR UNTIL IRRITATION SUBSIDES. CONSULT PHYSICIAN AS SOON AS POSSIBLE.

INHALATION OF A LARGE ENOUGH QUANTITY TO POSE A SIGNIFICANT HEALTH HAZARD IS IMPROBABLE.

INGESTION OF POWDER IS HARMFUL OR FATAL. SHOULD INGESTION OCCUR, DRINK MILK, RAW EGG WHITE, OR GELATIN SOLUTION, OR LARGE QUANTITIES OF WATER. AVOID ALCOHOL. CONSULT PHYSICIAN AS SOON AS POSSIBLE.

SECTION VI - REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID	NONE
	STABLE	X		
HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID	NONE
	WILL NOT OCCUR	X		
HAZARDOUS DECOMPOSITION PRODUCTS	UNDETERMINED			
INCOMPATIBILITY MATERIALS TO AVOID	OXIDIZING AGENTS SOAP AND ANIONIC SURFACTANTS DEACTIVATE GERMICIDES			

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED	SWEEP UP
WASTE DISPOSAL METHOD	REMOVE TO SANITARY LANDFILL AWAY FROM WATER SUPPLIES DESTROY EMPTY CONTAINERS

SECTION VIII - SPECIAL PROTECTION INFORMATION

SPECIAL RESPIRATORY PROTECTION	NOT REQUIRED
SPECIAL SKIN PROTECTION	NOT REQUIRED
SPECIAL EYE PROTECTION	NOT REQUIRED

SECTION IX - SPECIAL PRECAUTIONS

SPECIAL HANDLING PRECAUTIONS	NOT REQUIRED
SPECIAL STORAGE PRECAUTIONS	NOT REQUIRED.
OTHER SPECIAL PRECAUTIONS	NOT REQUIRED



LIQUID AIR CORPORATION
INDUSTRIAL GASES DIVISION

Material Safety Data Sheet

	PRODUCT NAME Hydrogen		
	TELEPHONE (415) 977-6500 EMERGENCY RESPONSE INFORMATION ON PAGE 2		
LIQUID AIR CORPORATION INDUSTRIAL GASES DIVISION One California Plaza, Suite 350 2121 N. California Blvd. Walnut Creek, California 94596	TRADE NAME AND SYNONYMS Hydrogen, Normal Hydrogen, Water Gas		CAS NUMBER 1333-74-0
	CHEMICAL NAME AND SYNONYMS Hydrogen		
ISSUE DATE OCTOBER 1, 1985 AND REVISIONS CORPORATE SAFETY DEPT.	FORMULA H ₂	MOLECULAR WEIGHT 2.016	CHEMICAL FAMILY Inorganic flammable gas

HEALTH HAZARD DATA

TIME WEIGHTED AVERAGE EXPOSURE LIMIT Hydrogen is defined as a simple asphyxiant. Oxygen levels should be maintained at greater than 18 molar percent at normal atmospheric pressure which is equivalent to a partial pressure of 135 mm Hg. (ACGIH, 1984-85)

SYMPTOMS OF EXPOSURE

Inhalation: High concentrations of hydrogen so as to exclude an adequate supply of oxygen to the lungs causes dizziness, deeper breathing due to air hunger, possible nausea and eventual unconsciousness.

TOXICOLOGICAL PROPERTIES

Hydrogen is inactive biologically and essentially nontoxic; therefore, the major property is the exclusion of an adequate supply of oxygen to the lungs.

Listed as Carcinogen
or Potential Carcinogen

National Toxicology
Program

Yes ☐
No ☒

I.A.R.C. Yes ☐
Monographs No ☒

OSHA Yes ☐
No ☒

RECOMMENDED FIRST AID TREATMENT

PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF OVEREXPOSURE TO HYDROGEN. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS AND BE COGNIZANT OF EXTREME FIRE AND EXPLOSION HAZARD.

Inhalation: Conscious persons should be assisted to an uncontaminated area and inhale fresh air. Quick removal from the contaminated area is most important. Unconscious persons should be moved to an uncontaminated area, given mouth-to-mouth resuscitation and supplemental oxygen. Medical assistance should be sought immediately.

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES

Hydrogen is flammable over a very wide range in air.

PHYSICAL DATA

BOILING POINT -422.98°F (-252.77°C)	LIQUID DENSITY AT BOILING POINT 4.4307 lb/ft ³ (70.973 kg/m ³)
VAPOR PRESSURE @ 70°F (21.1°C) above the critical temp. of -399.84°F (-239.91°C)	GAS DENSITY AT 70°F 1 atm .005209 lb/ft ³ (.08344 kg/m ³)
SOLUBILITY IN WATER @ 68°F (20°C) Bunsen coefficient = .0178	FREEZING POINT -434.565°F (-259.203°C)
APPEARANCE AND ODOR Colorless, odorless gas. Specific gravity @70°F (Air = 1.0) is .07.	

FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (METHOD USED) Gas	AUTO IGNITION TEMPERATURE 1058°F (570°C)	FLAMMABLE LIMITS % BY VOLUME LEL = 4; UEL = 74.5
EXTINGUISHING MEDIA Water, carbon dioxide, dry chemical		ELECTRICAL CLASSIFICATION Class 1, Group B
SPECIAL FIRE FIGHTING PROCEDURES If possible, stop the flow of hydrogen.. Cool surrounding containers with water spray. Hydrogen burns with an almost invisible flame of relatively low thermal radiation.		
UNUSUAL FIRE AND EXPLOSION HAZARDS Hydrogen is very light and rises very rapidly in air. Should a hydrogen fire be extinguished and the flow of gas continue, increase ventilation to prevent an (Continued on last page.)		

REACTIVITY DATA

STABILITY Unstable		CONDITIONS TO AVOID
Stable	X	
INCOMPATIBILITY (Materials to avoid) Oxidizers		
HAZARDOUS DECOMPOSITION PRODUCTS None		
HAZARDOUS POLYMERIZATION May Occur		CONDITIONS TO AVOID
Will Not Occur	X	

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Evacuate all personnel from affected area. Use appropriate protective equipment. If leak is in user's equipment, be certain to purge piping with an inert gas prior to attempting repairs. If leak is in container or container valve, contact the closest Liquid Air Corporation location.

WASTE DISPOSAL METHOD

Do not attempt to dispose of waste or unused quantities. Return in the shipping container properly labeled, with any valve outlet plugs or caps secured and valve protection cap in place to Liquid Air Corporation for proper disposal. For emergency disposal, contact the closest Liquid Air Corporation location.

EMERGENCY RESPONSE INFORMATION

IN CASE OF EMERGENCY INVOLVING THIS MATERIAL, CALL DAY OR NIGHT (800) 231-1366

OR CALL CHEMTREC AT 1-800-424-9303

SPECIAL PROTECTION INFORMATION

Page

RESPIRATORY PROTECTION (Specify type) Positive pressure air line with mask or self-contained breathing apparatus should be available for emergency use.		
VENTILATION	LOCAL EXHAUST To prevent accumulation above the LEL.	SPECIAL
Hood with forced ventilation	MECHANICAL (Gen.) In accordance with electrical codes.	OTHER
PROTECTIVE GLOVES Plastic or rubber		
EYE PROTECTION Safety goggles or glasses		
OTHER PROTECTIVE EQUIPMENT Safety shoes, safety shower		

SPECIAL PRECAUTIONS*

SPECIAL LABELING INFORMATION	
DOT Shipping Name: Hydrogen or Hydrogren, compressed	I.D. No.: UN 1049
DOT Shipping Label: Flammable Gas	DOT Hazard Class: Flammable Gas
SPECIAL HANDLING RECOMMENDATIONS	
<p>Use only in well-ventilated areas. Valve protection caps must remain in place unless container is secured with valve outlet piped to use point. Do not drag, slide or roll cylinders. Use a suitable hand truck for cylinder movement. Use a pressure reducing regulator when connecting cylinder to lower pressure (<3,000 psig) piping or systems. Do not heat cylinder by any means to increase the discharge rate of product from the cylinder. Use a check valve or trap in the discharge line to prevent hazardous back flow into the cylinder.</p>	
For additional handling recommendations consult L'Air Liquide's Encyclopedia de Gaz or Compressed Gas Association Pamphlet P-1.	
SPECIAL STORAGE RECOMMENDATIONS	
<p>Protect cylinders from physical damage. Store in cool, dry, well-ventilated area of non-combustible construction away from heavily trafficked areas and emergency exits. Do not allow the temperature where cylinders are stored to exceed 130F (54C). Cylinders should be stored upright and firmly secured to prevent falling or being knocked over. Full and empty cylinders should be segregated. Use a "first in-first out" inventory system to prevent full cylinders being stored for excessive periods of time. Post "No Smoking or Open Flames" signs in the storage or use area. There should be no sources of ignition in the storage or use area.</p>	
For additional storage recommendations consult L'Air Liquide's Encyclopedia de Gaz or Compressed Gas Association Pamphlet P-1.	
SPECIAL PACKAGING RECOMMENDATIONS	
<p>Hydrogen is noncorrosive and may be used with any common structural material.</p>	
OTHER RECOMMENDATIONS OR PRECAUTIONS	
<p>Earth-ground and bond all lines and equipment associated with the hydrogen system. Electrical equipment should be non-sparking or explosion proof. Compressed gas cylinders should not be refilled except by qualified producers of compressed gases. Shipment of a compressed gas cylinder which has not been filled by the owner or with his (written) consent is a violation of Federal Law (49CFR).</p>	

*Various Government agencies (i.e. Department of Transportation, Occupational Safety and Health, etc.)



LIQUID AIR CORPORATION
INDUSTRIAL GASES DIVISION

ADDITIONAL DATA

UNUSUAL FIRE AND EXPLOSION HAZARDS: (Continued)

explosion hazard, particularly in the upper portions of buildings or sheds where the gas might "collect".

MSDS for ALCONOX(R)
-----Page 1

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: ALCONOX(R)
FORMULA:
FORMULA WT: .00
CAS NO.: - -
COMMON SYNONYMS: ALKYL ARYL SULFONATES
PRODUCT CODES: A461
EFFECTIVE: 11/22/85
REVISION #01

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH	-	1	SLIGHT
FLAMMABILITY	-	0	NONE
REACTIVITY	-	1	SLIGHT
CONTACT	-	2	MODERATE

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

SAFETY GLASSES; LAB COAT

PRECAUTIONARY LABEL STATEMENTS

WARNING

CAUSES IRRITATION

KEEP IN TIGHTLY CLOSED CONTAINER. WASH THOROUGHLY AFTER HANDLING.

SAF-T-DATA(TM) STORAGE COLOR CODE: ORANGE (GENERAL STORAGE)

2 - HAZARDOUS COMPONENTS

COMPONENT

%

CAS NO.

ALCONOX(R)

90-100

3 - PHYSICAL DATA

BOILING POINT: N/A VAPOR PRESSURE(MM HG): N/A
MELTING POINT: N/A VAPOR DENSITY(AIR=1): N/A
SPECIFIC GRAVITY: 0.00 EVAPORATION RATE: N/A
(H2O=1) (BUTYL ACETATE=1)
SOLUBILITY(H2O): APPRECIABLE (MORE THAN 10 %) % VOLATILES BY VOLUME: N/A

MSDS for ALCONOX(R) Page 2
-----APPEARANCE & ODOR: WHITE OPAQUE POWDER.

4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP: N/A
FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %
FIRE EXTINGUISHING MEDIA
USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

5 - HEALTH HAZARD DATA

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE
CONTACT WITH SKIN OR EYES MAY CAUSE IRRITATION.
INGESTION MAY BE HARMFUL.

TARGET ORGANS

7/31/97

9:15:00 AM

NONE IDENTIFIED

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
NONE IDENTIFIED

ROUTES OF ENTRY
NONE INDICATED

EMERGENCY AND FIRST AID PROCEDURES

CALL A PHYSICIAN.

IF SWALLOWED, IF CONSCIOUS, IMMEDIATELY INDUCE VOMITING.

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH PLENTY OF WATER FOR
AT LEAST 15 MINUTES.

6 - REACTIVITY DATA

STABILITY: STABLE

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: NONE DOCUMENTED

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE

WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING.

WITH CLEAN SHOVEL, CAREFULLY PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND
COVER; REMOVE FROM AREA. FLUSH SPILL AREA WITH WATER.

MSDS for ALCONOX(R)

Page 3

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL
ENVIRONMENTAL REGULATIONS.

8 - PROTECTIVE EQUIPMENT

VENTILATION: USE ADEQUATE GENERAL OR LOCAL EXHAUST VENTILATION
TO KEEP FUME OR DUST LEVELS AS LOW AS POSSIBLE.

RESPIRATORY PROTECTION: NONE REQUIRED WHERE ADEQUATE VENTILATION
CONDITIONS EXIST. IF AIRBORNE CONCENTRATION IS
HIGH, USE AN APPROPRIATE RESPIRATOR OR DUST MASK.

EYE/SKIN PROTECTION: SAFETY GLASSES WITH SIDESHIELDS, PROPER GLOVES ARE
RECOMMENDED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: ORANGE (GENERAL STORAGE)

SPECIAL PRECAUTIONS

KEEP CONTAINER TIGHTLY CLOSED. SUITABLE FOR ANY GENERAL CHEMICAL STORAGE
AREA.

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME CHEMICALS, N.O.S. (NON-REGULATED)

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME CHEMICALS, N.O.S. (NON-REGULATED)